Plastics

DEALING WITH THE MANUFACTURE, USES AND POTENTIALITIES OF PLASTIC MATERIALS

TECHNOLOGY DEPT.

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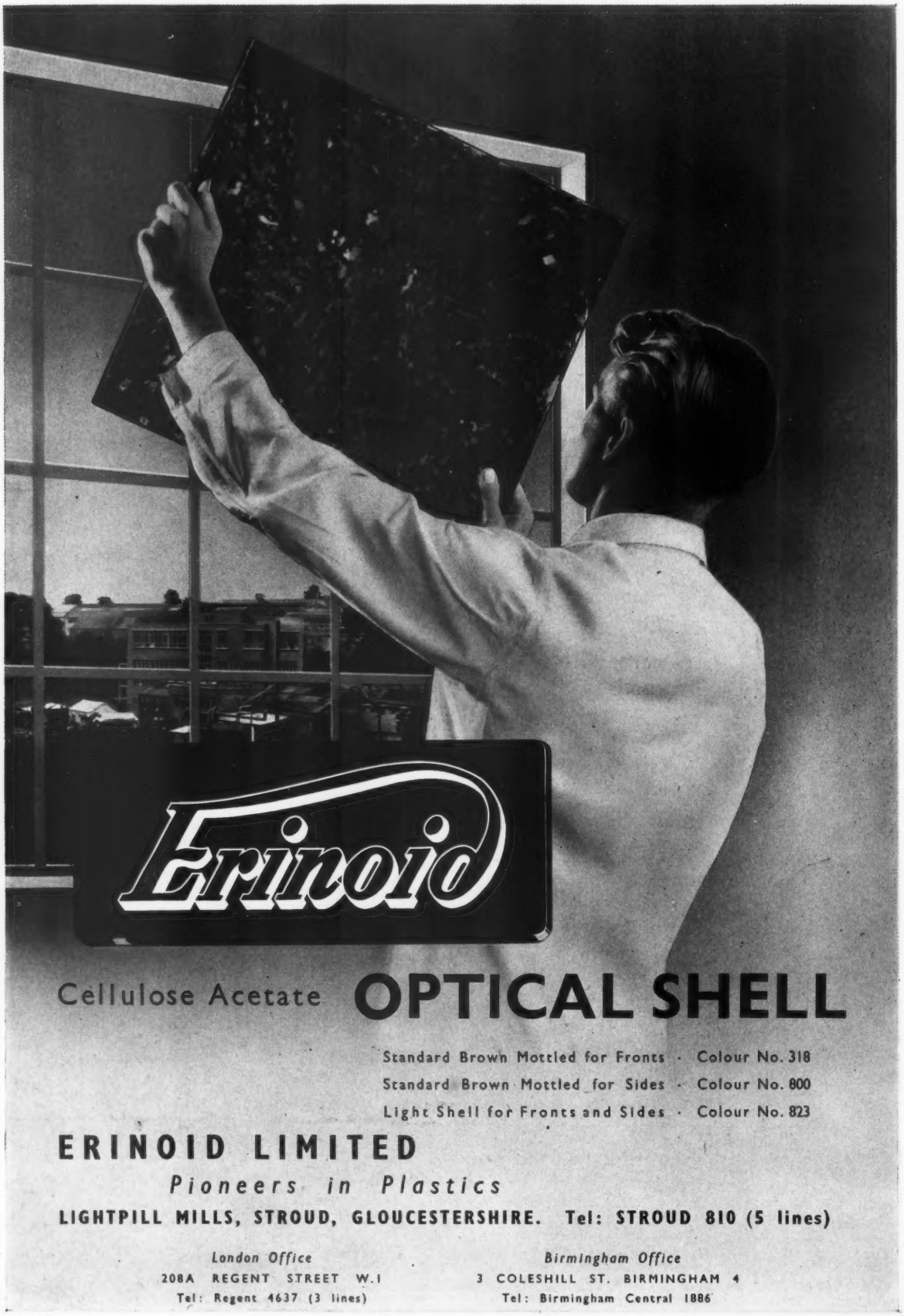

Cellulose Acetate **OPTICAL SHELL**

Standard Brown Mottled for Fronts · Colour No. 318
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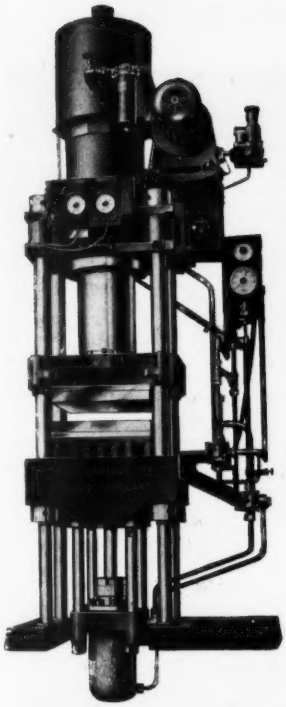

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We supply a complete range of machinery and equipment including :

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Herbert/Reed-Prentice 5A 4 ozs. ,, ,,
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Reed-Prentice 10E 12 ozs. ,, ,,
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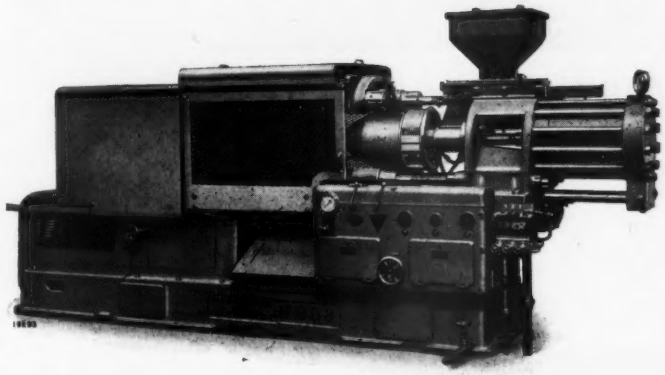

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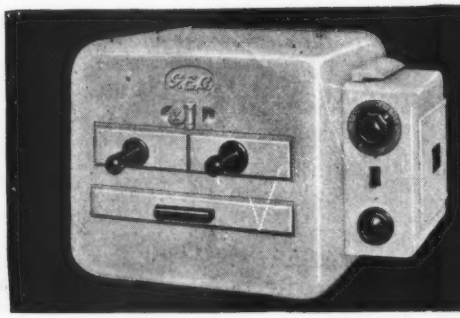

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for two different types of thermostat control, made for the Rheostatic Co. Ltd. of Slough by . . .

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GENTLEMEN—
THE TARTAN!

"Here's to it;
The fighting sheen of it;
The yellow, the green of it;
The white, the blue of it;
The dark, the red of it;
Every thread of it;
The fair have sighed for it;
The brave have died for it;
Foemen sought for it;
Honour the name of it;
Drink to the fame of it—
The Tartan!"

DURAPLEX (Plastics) LTD., 14, CAXTON STREET, LONDON, S.W.1
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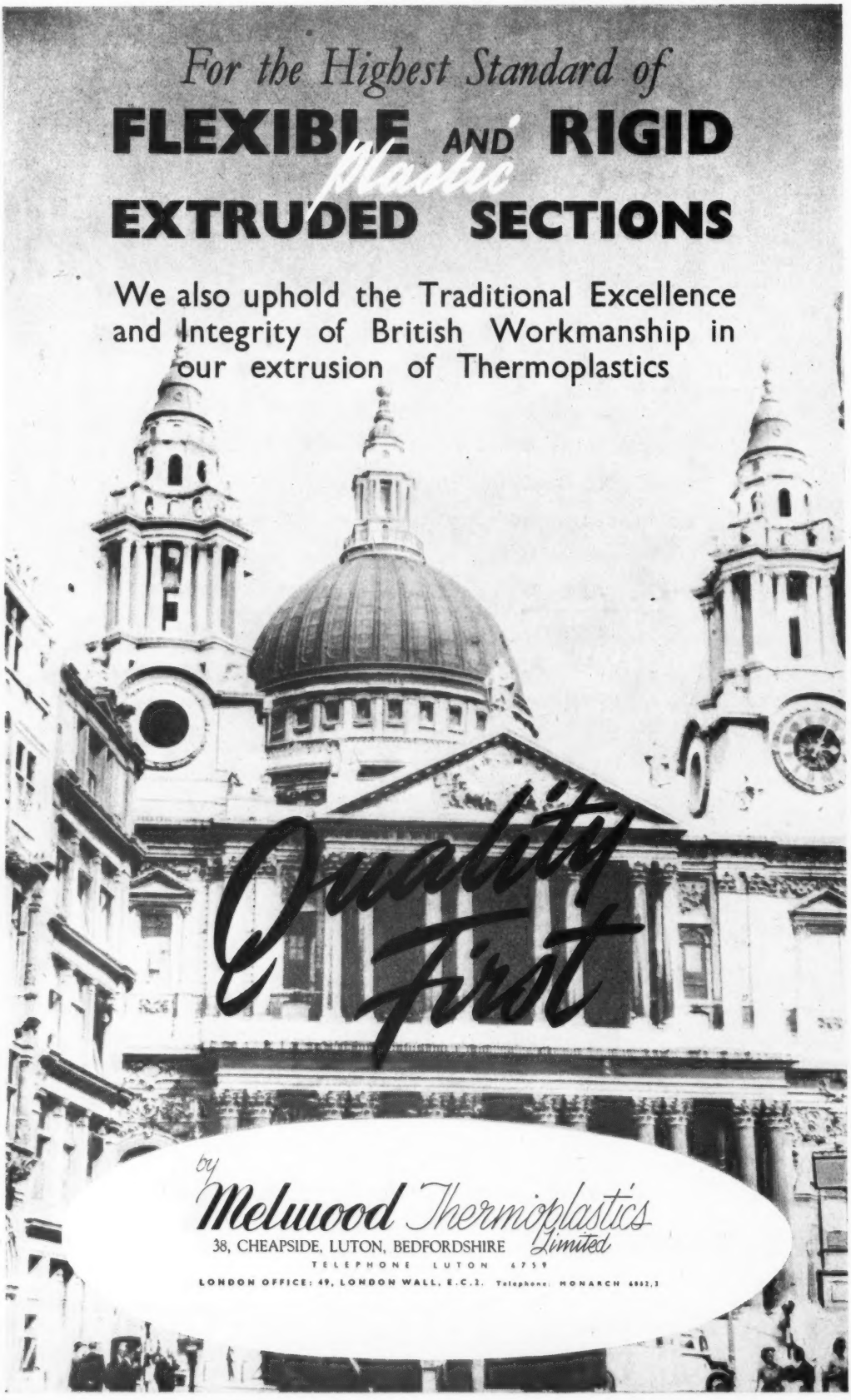
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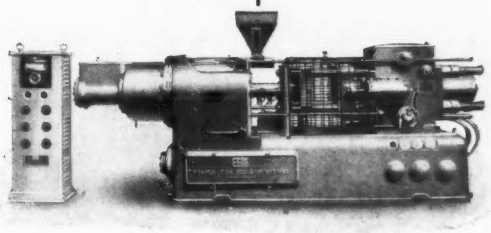
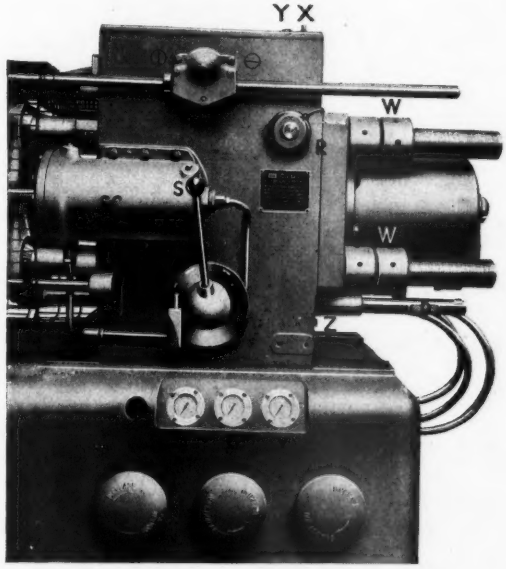
TELEPHONE LUTON 6759
LONDON OFFICE: 49, LONDON WALL, E.C.2. Telephone: MONARCH 4002,3

P. For setting platen stroke
R. For injection timing
S. Single operating lever
T. Forward injection pressure
U. Return injection and return locking pressure
V. Locking pressure
W. Main locking nuts
X. Dipstick
Y. Oil filler plug
S.C. Side cylinder





Single Lever Control

All operational movements are controlled by means of a single interlocked lever S—operational functions can only take place in correct sequence. Movement of lever to left closes the die under a light force of 3.8 tons—increasing distance of lever from neutral position increases speed of movement. A further movement applies locking force of 136 tons. Final movement to left injects material into die. A continuous movement of lever to right, in turn releases injection and locking pressures, opens the die and ejects the moulding.

EMB

Patent No. 9B INJECTION MOULDER

FEATURES

- Temperature automatically controlled
- Controllable heating zone
- Single handle operation
- Interlocked handle gives correct sequence
- Patent compensating feed
- Timed injection cycle prevents "scamped" mouldings
- Dies have 136-ton direct lock—no toggles to wear or jam
- Automatic attachment available as an extra
- Interlocked sliding gate guard
- All air cylinders and rams are hard chromium plated

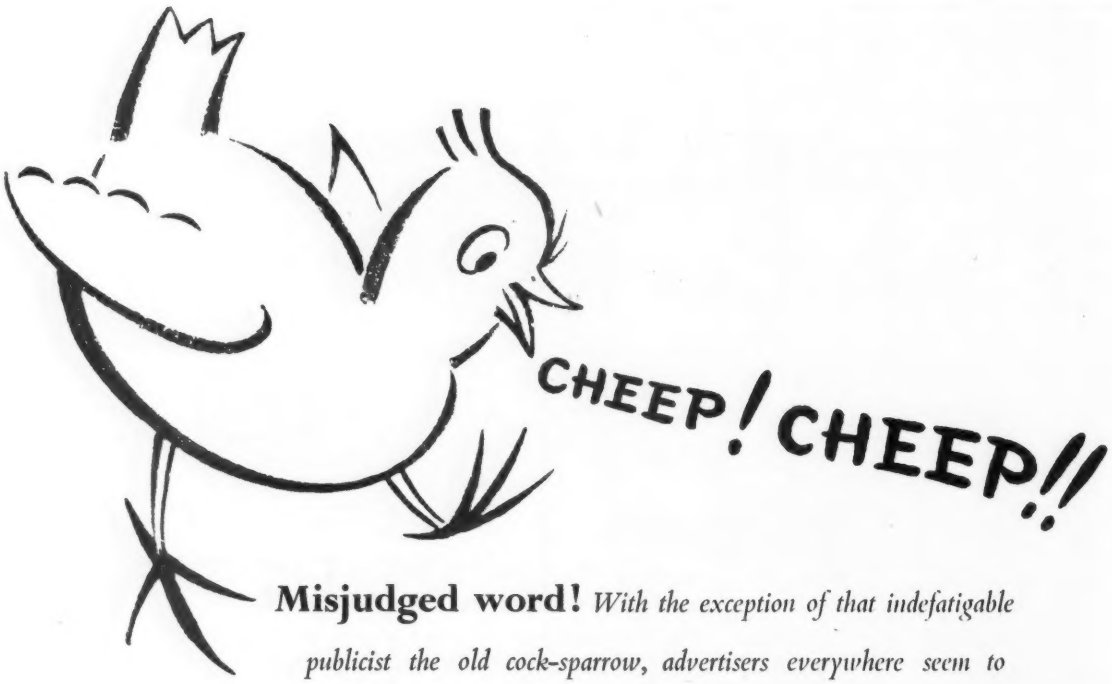
CAPACITY

Plasticising capacity	4 oz. cyl. : 34 lb./hr. in cell. acet. 2 oz. cyl. : 26 lb./hr. in cell. acet.
Distance between bars	11¾ in. x 10 in.
Maximum and minimum die thickness	12 in.—2 in.
Movement of die platen	7¾ in.
Maximum area of work at 7 tons/sq. in.	36 sq. in.
Locking force	136 tons
Injection pressure	4 oz. cyl. : 7·6 tons/sq. in. max. 2 oz. cyl. : 11·9 tons/sq. in. max.

EARLY DELIVERY

E.M.B. Co. Ltd.

WEST BROMWICH—ENGLAND



Misjudged word! *With the exception of that indefatigable publicist the old cock-sparrow, advertisers everywhere seem to fight shy of the word "cheap". Nasty tang of shoddiness and inferiority about it, they say. So they bowdlerize it into "low in cost", "attractively priced", and so forth. ¶ How wrong they are! What is shoddy and inferior cannot possibly be cheap. It must be in the highest degree expensive—and, all through its short, unhappy life, an unremitting pain in the neck. ¶ Anyhow* we *don't boggle at the word. The Secondhand Plant and Machinery we sell is cheap. That is to say, it is reliable, efficient, modern, cheap in first cost, cheap to run, and good in every way. We carry the largest stocks in the country and we will not stock, or sell, inferior Plant because that spells trouble for all concerned.*

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P/498/P202

The Chemical Resistance

OF MONSANTO Lustrex

POLYSTYRENE MOULDING CRYSTALS

One of the characteristics of Lustrex is strong chemical resistance. Acids, alkalis, and alcohols do not affect it. The acid resistance of Lustrex enables its use in parts where metals would be attacked. Even hydrofluoric acid, which attacks glass, has no deleterious effect on Lustrex. Its chemical resistance to various substances is shown in the table below

WATER	unaffected
ALKALIS	unaffected
ESSENTIAL OILS	surface and colour affected by some
ALIPHATIC HYDROCARBONS	unaffected
ACIDS	unaffected
ALCOHOLS	unaffected
AROMATIC HYDROCARBONS	soluble
CHLORINATED HYDROCARBONS	soluble

QUICK FACTS ABOUT LUSTREX . . . Low cost per pound . . . Lightweight . . . Faster moulding . . . New brilliance and clarity . . . No taste or odour . . . High dimensional stability . . . Good chemical resistance . . . Excellent electrical qualities . . . Gay colour range.

Write to Plastics Department, **MONSANTO CHEMICALS LIMITED**
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B

Multi-screw L.M.P. 90 mm. RC-3

- compounds
- extrudes
- colours
- reclaims scrap

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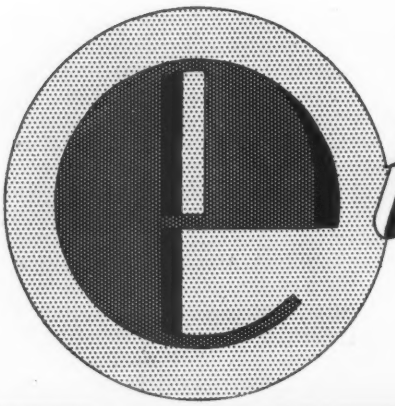
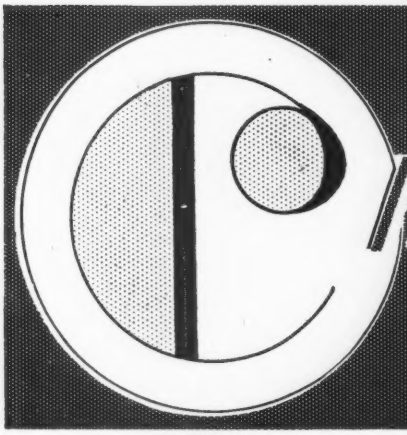
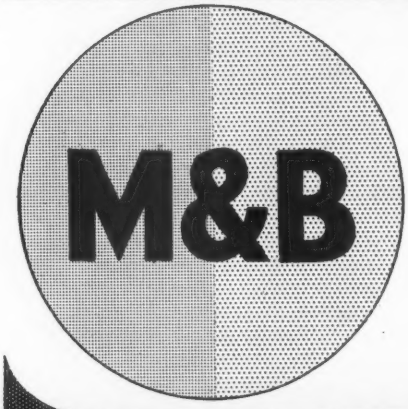


ther-M&B



hloroform M&B



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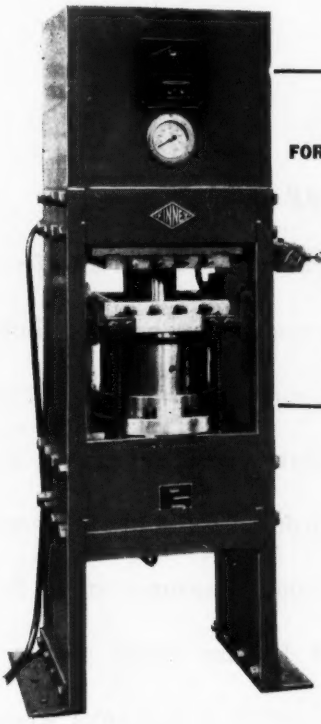

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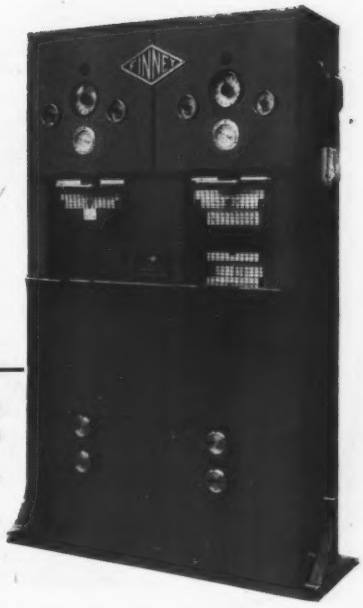
Compact, space-saving design. From 200-1,000 tons.

Ample daylight and bolster area. Fabricated in high-tensile steel. Completely self-contained.



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Automatic time cycle control.
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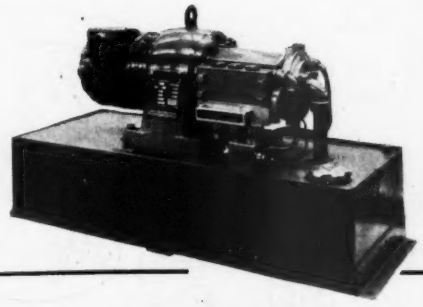

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It may also be used to shear gates, pierce or engrave under part of moulding, or to eject. The horizontal injection on it is of conventional type and may be supplied with interchangeable cylinders of varying capacities 8-32 ozs.

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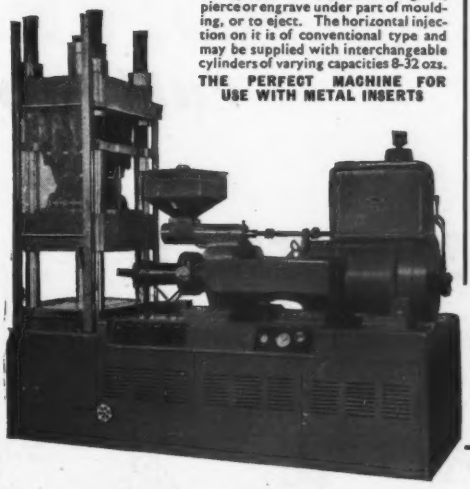

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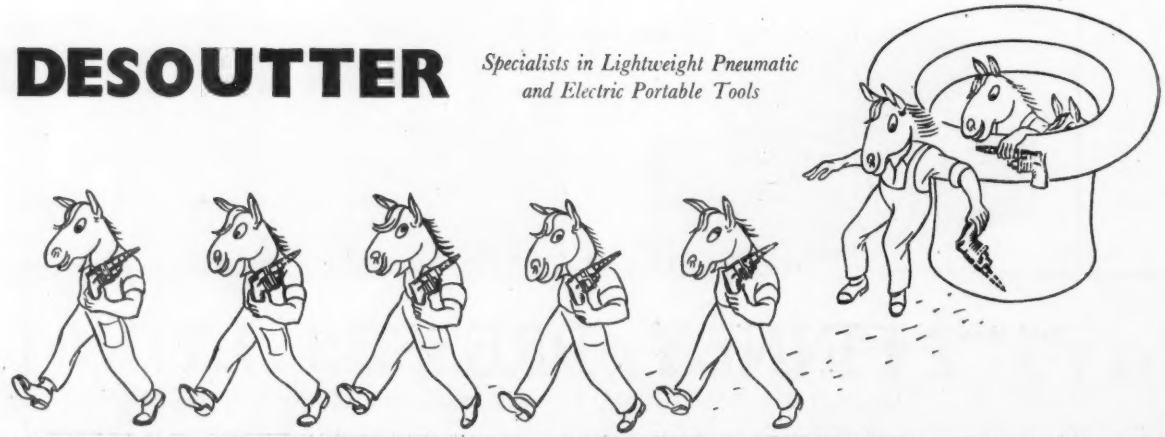

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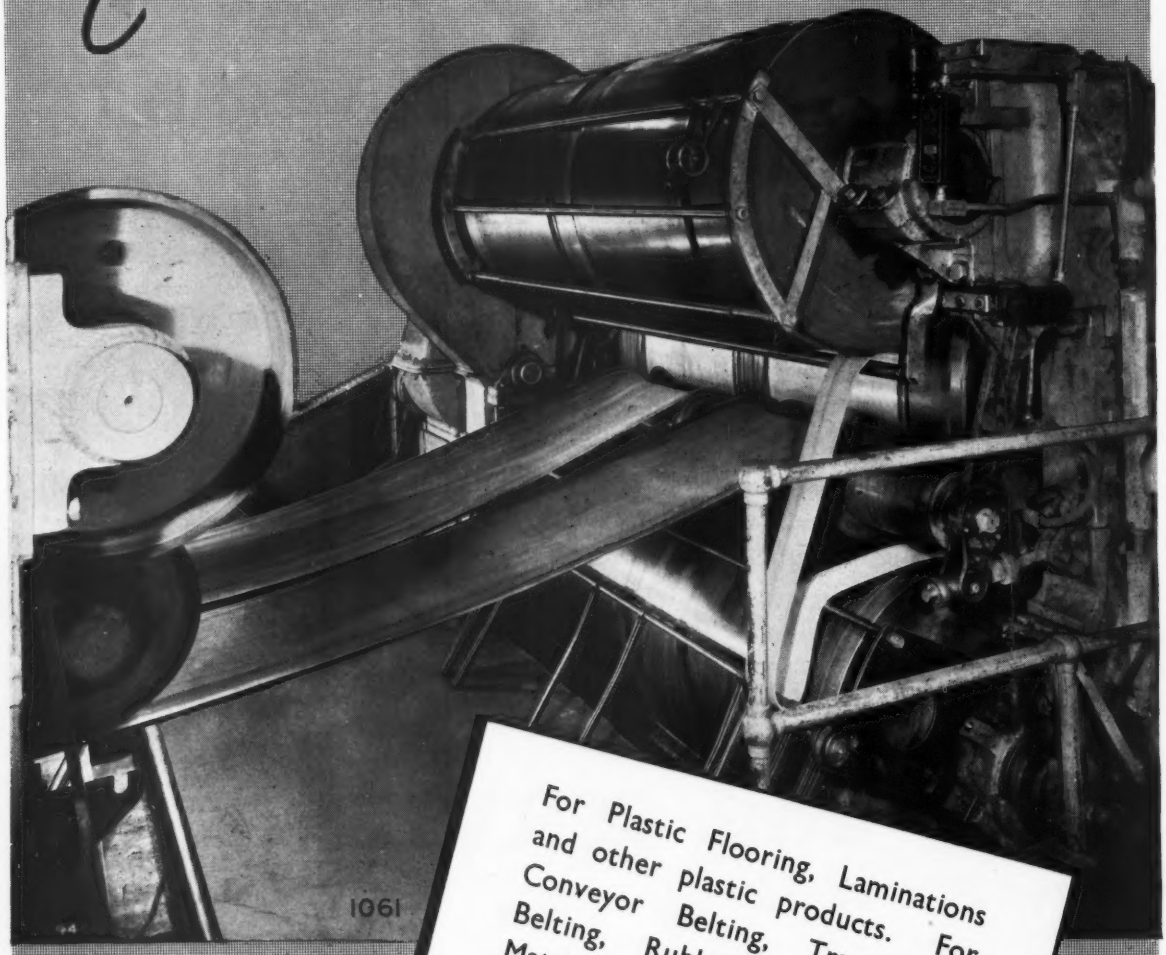

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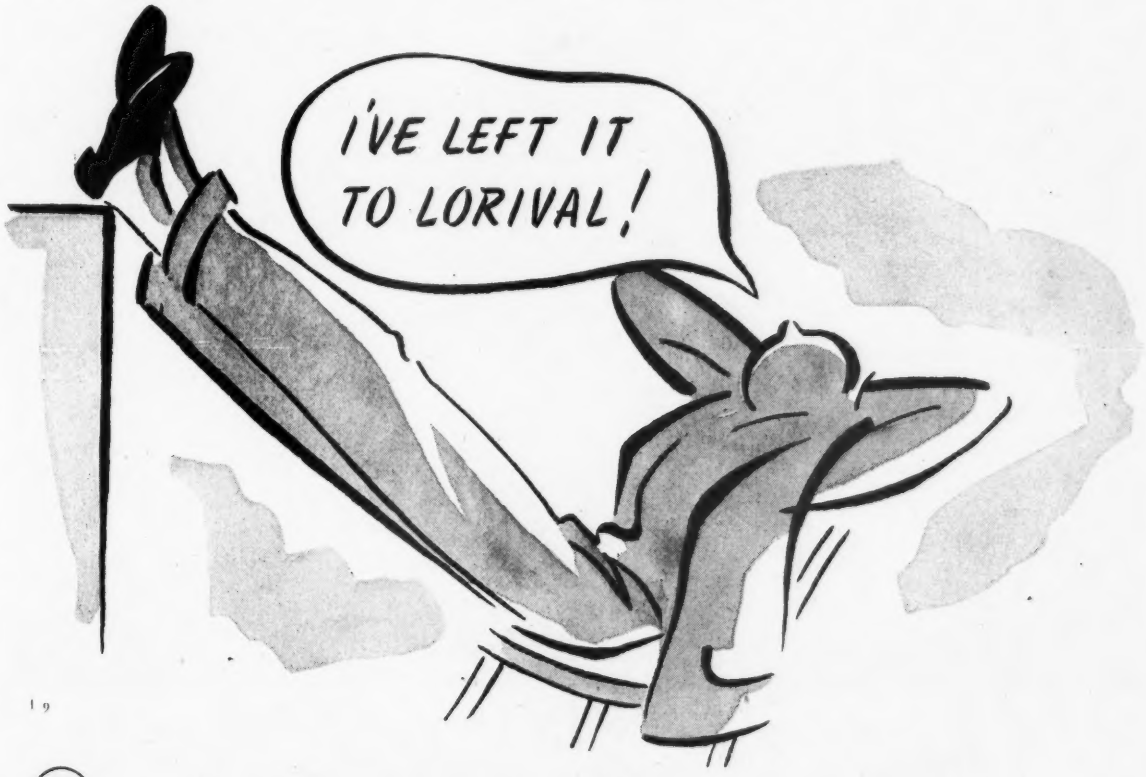

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But what about your cradle, will it stand the shock?
Oh yes, it's made of Wockite *
so it doesn't weally matter,
Dwop it, knock it, tweat it wough,
this plastic doesn't shatter!

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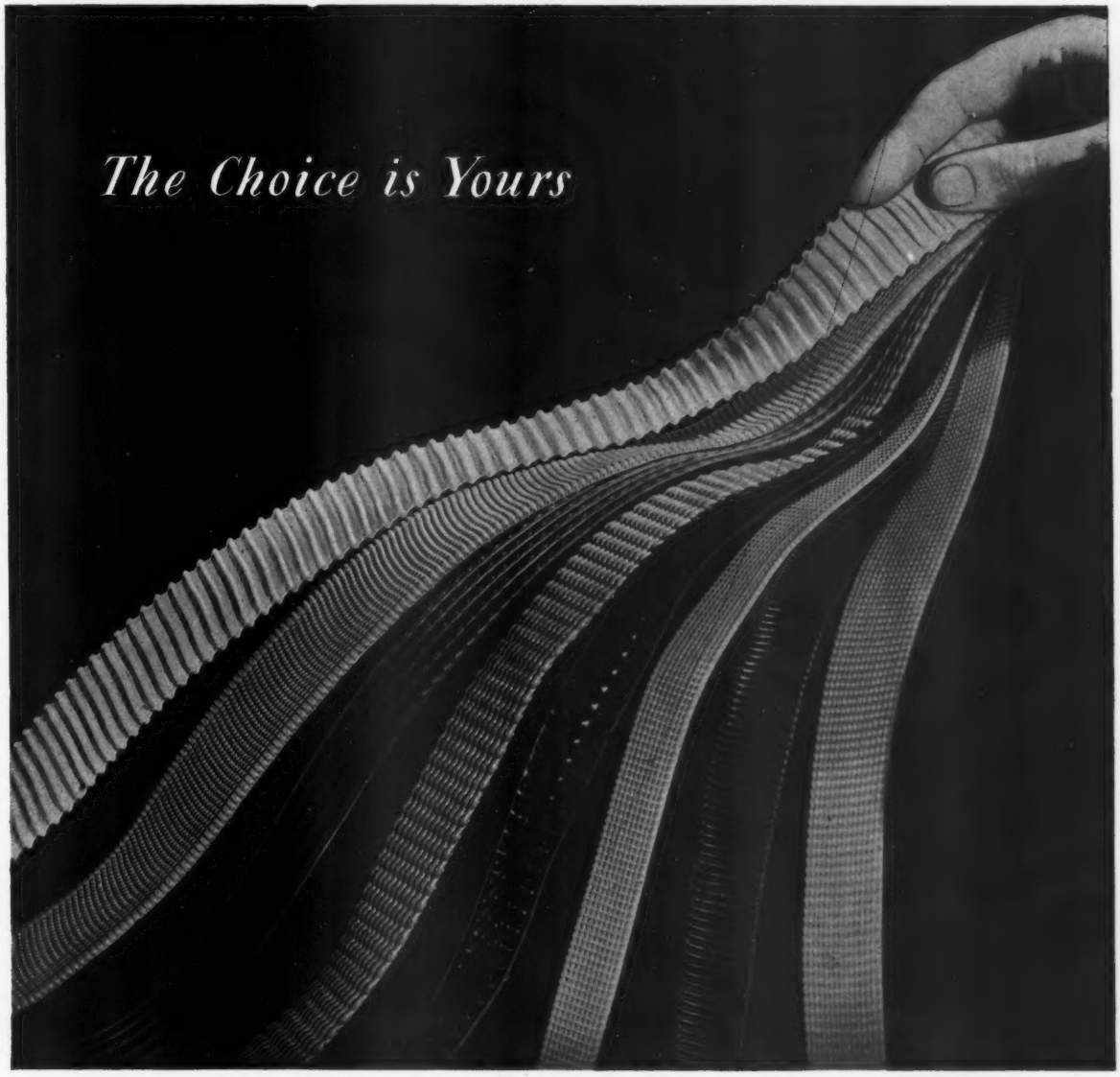

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- VERTICAL SPINDLE MOULDING MACHINE
- MOULDING AND PLANING CUTTER GRINDER
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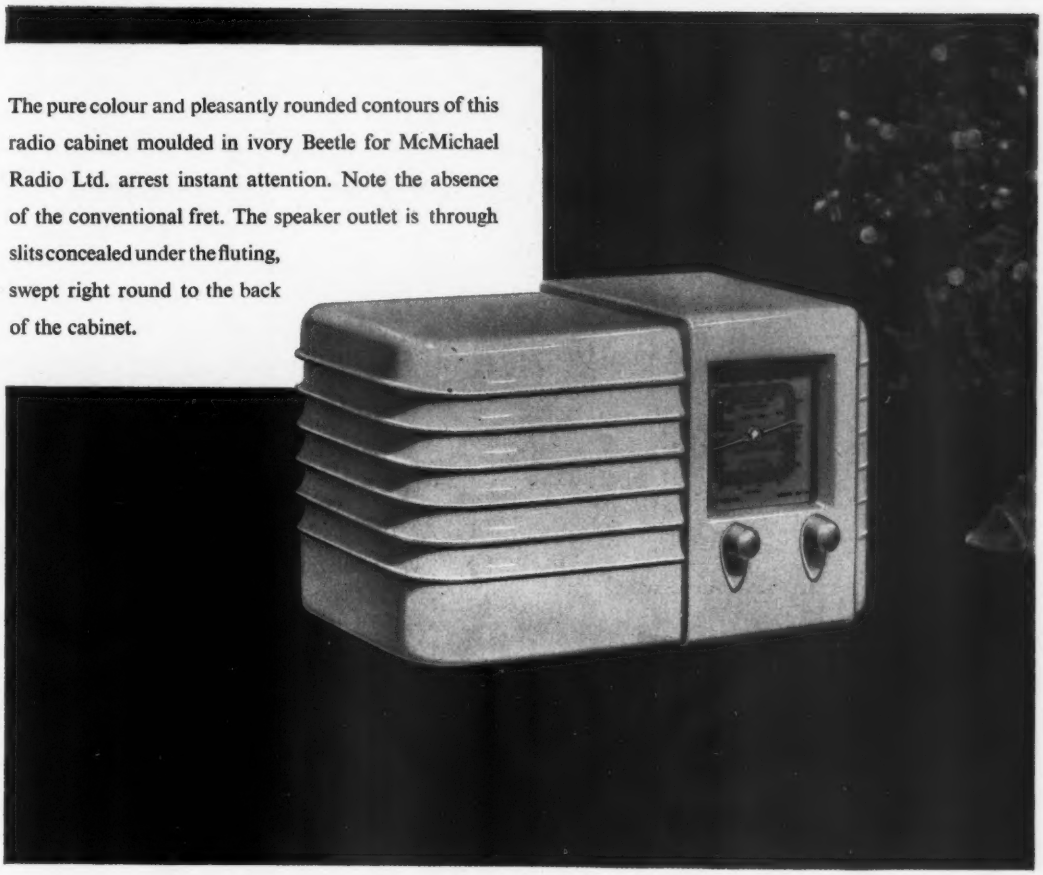

The pure colour and pleasantly rounded contours of this radio cabinet moulded in ivory Beetle for McMichael Radio Ltd. arrest instant attention. Note the absence of the conventional fret. The speaker outlet is through slits concealed under the fluting, swept right round to the back of the cabinet.

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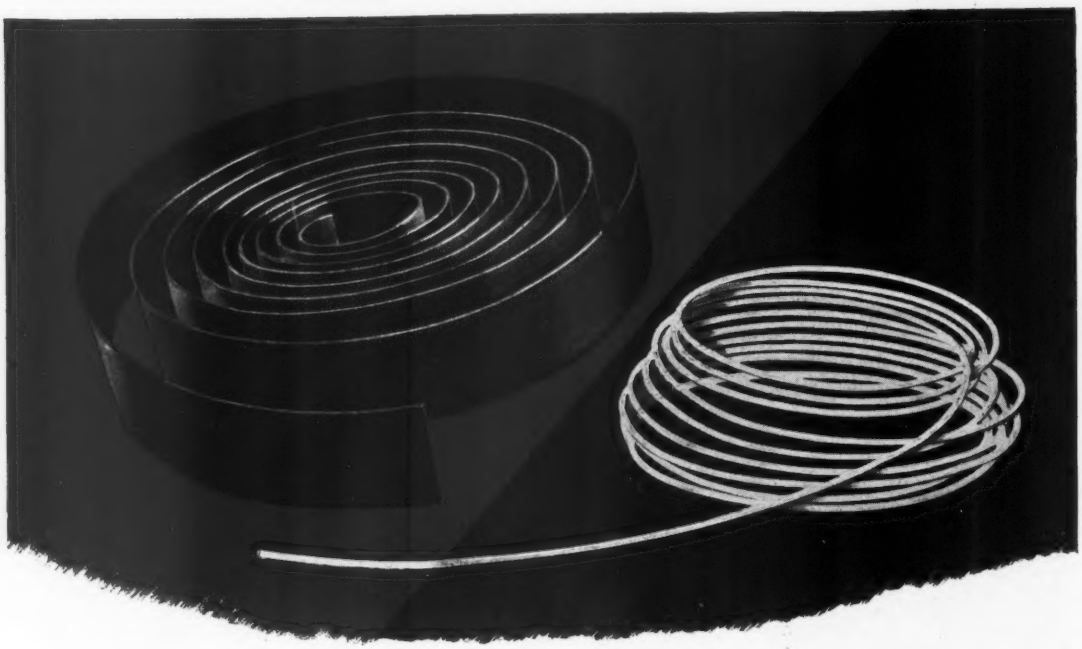

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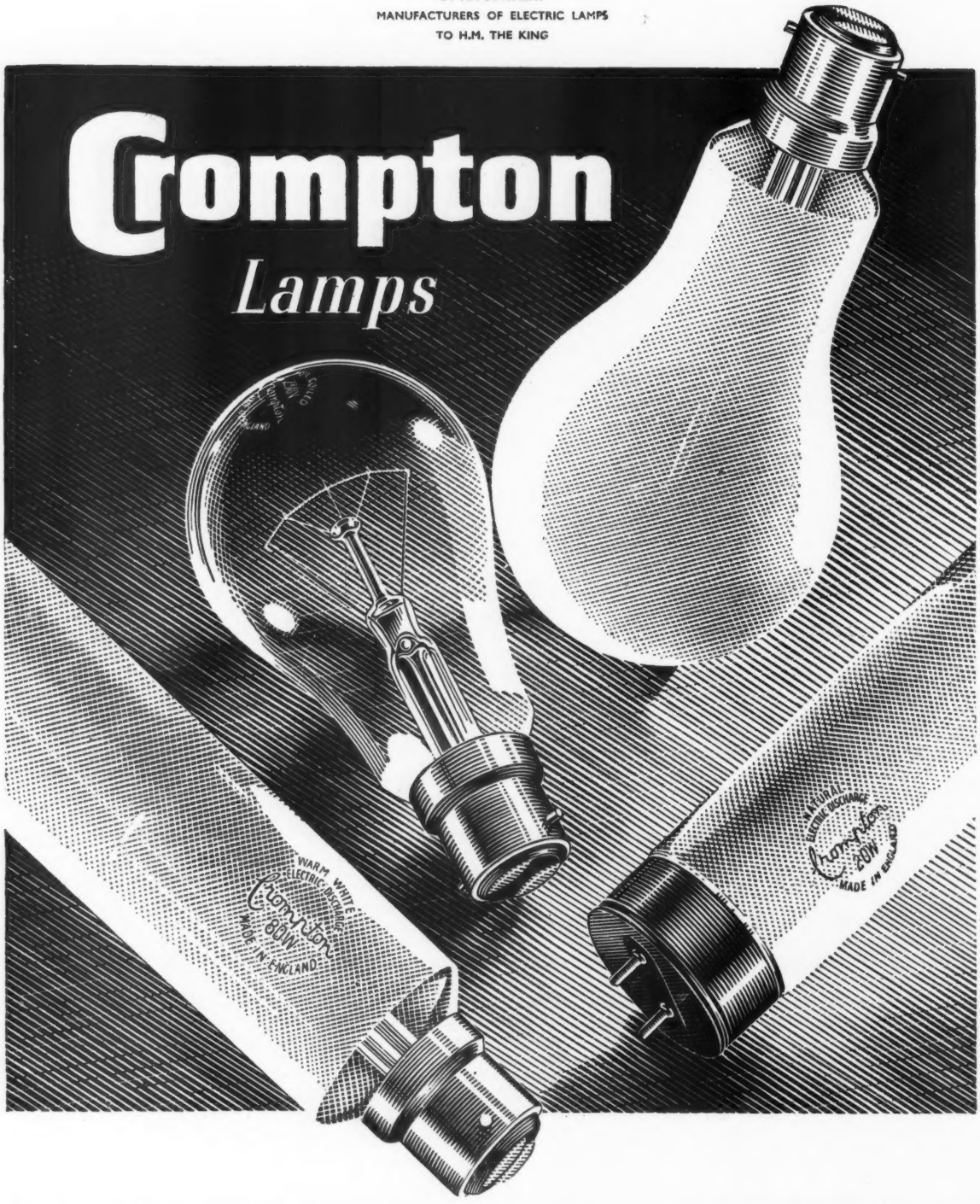

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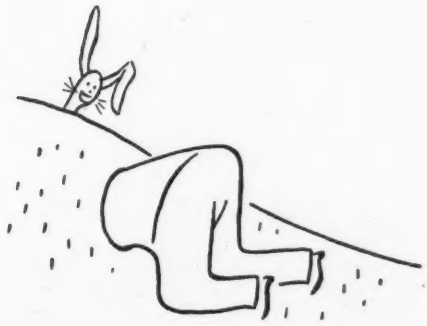

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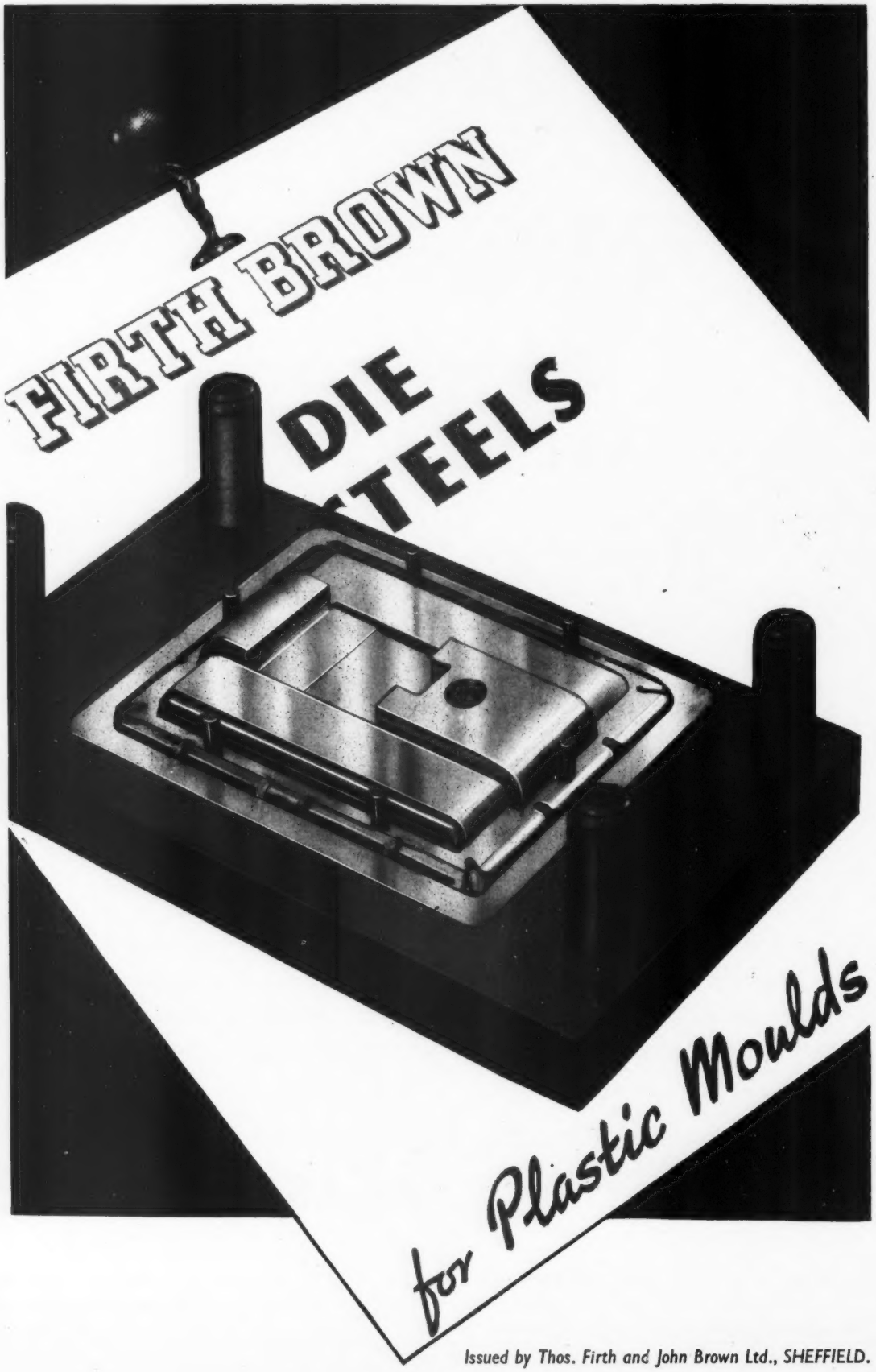

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A timely reminder

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T.A. 2903

THE BAKELITE SERVICE TO MOULDERS . . . No. 7

We shall doubt the moulded pre-war coffin must still rank as the largest moulding in the world. It weighed 70 lb. and was in Bakelite material, of course.

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Plastics

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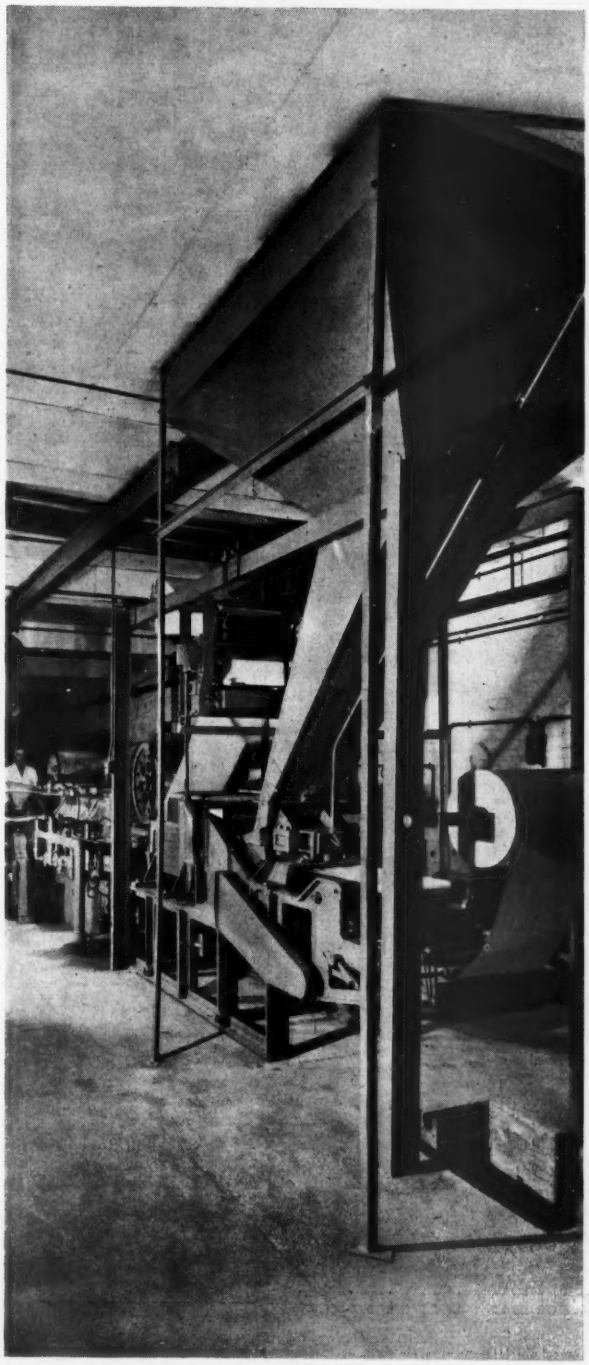

EDITOR: M. D. CURWEN, B.Sc., A.R.I.C.

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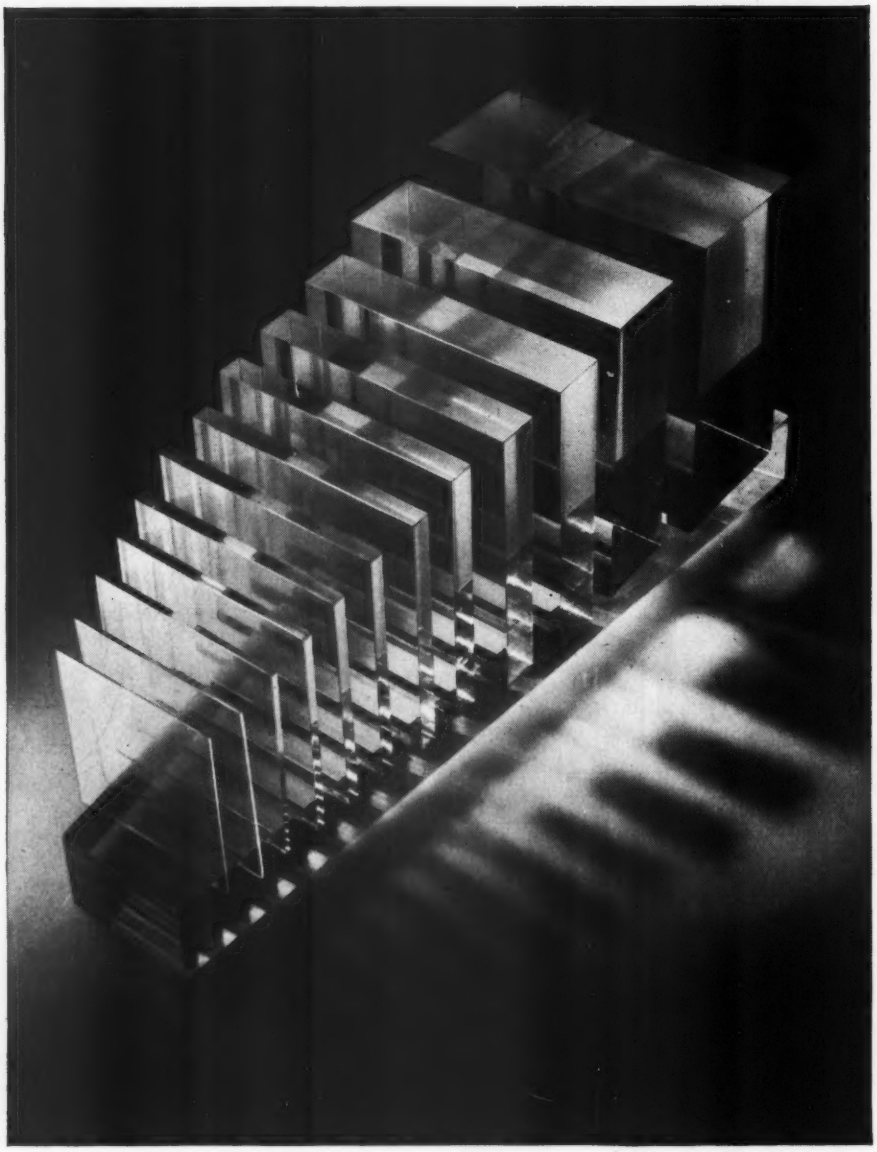
General view of experimental B.A.R. machine (see "Plastics," 1948/626).

'PERSPEX'

ACRYLIC SHEET



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ICI

P.350

Plastics

VOL. XIV. No. 150. NOVEMBER, 1949.

"A manufacturer of surgical instruments in Paris is in the habit of rendering ivory flexible for use as tubes, probes, etc., by acting on the well-known fact, that when bones are subjected to the action of hydrochloric acid, the phosphate of lime, which forms one of their component parts, is extracted, and thus bones retain their original form, and acquire great flexibility. M. Charriere, after giving the pieces of ivory their required form and polish, steeps them in acid, either pure or diluted, until they become supple and elastic, and of a slightly yellow colour. In the course of drying the ivory returns to its original hardness, but its flexibility can be easily restored by surrounding it with wet linen, or by placing wet sponge in the cavities of the pieces."

From: "Cyclopædia of Useful Arts." Edited by Charles Tomlinson. London, 1854.

EDITORIALS

Industrial Simplification

THE Report of the Committee for Standardization of Engineering Products appointed by the Ministry of Supply has now been published (H.M. Stationery Office, price 9d. net.). Concurrently the Anglo-American Council on Productivity has published a report on Simplification in Industry (21, Tothill Street, London, S.W.1, price 1s.). Both independent reports come to the same conclusion, that measures of simplification result in increased output, lower manufacturing costs and reduced selling prices, results that would solve many of our present-day problems. In addition to examining the problem of simplification, which is the process of reducing the number of types, the Committee for Standardization of Engineering Products worked also on the problem of standardization which is so inter-related with it. Generally speaking, the advantages of simplication may be summarized as:—

1. Longer runs with fewer changes on the production line.
2. Reduced tooling and set-up time.
3. Possibilities of increased mechanization and special-purpose plant.
4. Easier training of operatives.
5. Simpler and cheaper inspection.
6. Less capital invested in idle plant, tools, and space.
7. Reduction of stocks of materials, components, and end-products. Easier maintenance.

Every one of these factors affects closely much production in the plastic moulding factory, and, indeed, all fabricating units, especially so far as electrical equipment, radio and television, pipe fittings and valves, motorcars, nuts and bolts, etc., are concerned. It is easy to imagine, in addition, the saving in mould production, use and maintenance.

There is little doubt that such a movement would prove very beneficial, and in many productions the need for simplification is urgent. Doubtless the obvious cases would be tackled first. The immediate field is wide enough to avoid clashes with the problems of new designs or indeed with the growing demand for art in industry.

Caravans

AS we noted last month, there was little to report as a result of our visit to the Motor Show. It is to be regretted that the complete facia board of moulded plastics, which was among the best jobs turned out by some of our larger moulding concerns, has been replaced, following American technique. The smaller instrument panel, and very attractive it is, has taken its place, generally in pastel shades. Admittedly, here, there is more conformity to general colour demands, for most car-builders, probably to satisfy American tastes, are matching instrument panel, instrument knobs, door-winders and gear-knobs, with considerably improved results. There is, of course, no dearth of plastics in the modern motorcar, from battery boxes to steering wheels, which are now universally covered, and from cable coverings to seat-"leather," where p.v.c. is now regarded as a hard-wearing material that cannot be ignored.

As to the structure of the coachwork itself, nothing new from the plastic angle has appeared.

When we turn to that comparatively newcomer to the world of movement of wheels—the caravan—we find in the same show, more encouragement. Indeed, its very purpose and the fact that it must be trailed, makes it perfectly amenable to the wide use of plastics—it must be light and strong.

Thus already there is considerable use of laminated sheet, especially for the curved portion of the body. Furthermore, since the trailers are temporary and permanent homes, in fact, small houses on wheels, good insulation, ventilation and natural lighting are of the utmost importance. It is, therefore, pleasing to learn that "Isoflex," the exceptionally light, expanded cellulose acetate, which is sufficiently rigid to be installed simply and rapidly, is finding favour here as an insulator. Its worth has already been proved for the purpose in railway refrigerated wagons.

Almost all the trailers on view possessed "skylights" for ventilation and lighting, one noteworthy point about certain types being that they were moulded in square, dish-like forms so that when closed, rain was completely excluded. The desire of lightness in weight is also seen in the provision of plastic hand-basins and sinks and it is encouraging to note that caravan manufacturers consider them exceptionally hard-wearing and pleasing to the eye.

There is little doubt that these perambulating homes have come to stay and, indeed, there is every indication that with better organization for their reception at holiday resorts their numbers will increase. We feel convinced that with greater use of plastics for wall structure and greater study of modern methods of producing double curvatures with light and ultra-light plastics, the design, so far as the re-shaping of the completely vertical and rather ugly side walls is concerned, will be greatly improved and give more internal capacity.

Tools for Industry

SINCE reiteration, according to our pundits, is the essence of forceful progaganda, it is of value to repeat that if plastics can prove themselves in engineering, then it will follow that they will prove themselves in most other industries.

Whilst the pedant, and most of us, can pick holes in this argument, there is, nevertheless, a good deal of truth in it, and the plastics industry regards the engineering industry as its most important testing house. Much of the research carried out but it, both as regards raw material and technique of moulding and fabrication, is directed towards satisfying the severe demands.

The mechanical section of the engineering industry, with its need for high mechanical strengths in its equipment, has been a difficult field to enter. Indeed, 15 or 20 years ago plastic units in it were almost unknown. To-day, the breach is considerable and some of the results both spectacular and gratifying. To give one early example of the success and the exigencies of the testing methods, we may note that although heavy-duty bearings had been suggested before 1936, yet it was not until our July issue of 1947 that we were able to publish a full technical and economic analysis of their success and exceptional advantages over conventional phosphor-bronze bearings used in a steel rolling mills in England. The test had taken many years to complete and evaluate.

It is therefore with exceptional pleasure that in this issue of "Plastics" we devote the pages of "Plastics in the Service of Man" to tools and mechanical equipment. From them the reader will see how far we have travelled in the past 20 years and, more pleasurably, how far moulded plastics, in addition to the laminated type have succeeded in entering a field of industry traditionally held by metals only.

MOULDING POWDER AND SHOT

Sheet Thickness

A reader inquires in the "Letters" page as to the availability of devices for measuring the thickness of p.v.c., as it comes off the calender, by radio-active means. There are, so far as my knowledge goes, no organization which makes them here, nor any factory that makes use of them. Electrical methods are employed and electronic means are sometimes possible, but to date most of the radio-active research has been carried out in the U.S.A. in conjunction with the Atomic Energy Commission. Tracerlab, Inc., has been especially to the fore in this respect and now produces a series of Beta Gauges for industrial purposes using isotopes produced at Oak Ridge. Necessary equipment consist of a source of beta radiation and a radiation detector, the part of the radiation absorbed by the interposed sheet plastic being proportional to its weight per unit area. It is then possible to read weight per unit area on a meter or recorder. The radioactive material used is Strontium 90.

* * *

Window Signs

During the past few months I have had a good many requests for information about plastic lettering for fixing on the inside of plastic windows There's no mystery about the type referred to and the idea's as old as the hills although the person who first thought of using soft flexible plastic sheeting for the job deserves a pat on the back. It is so simple and may prove an interesting little business for somebody if it isn't overdone. The material is p.v.c. sheeting and although any of this sheeting with a good surface may do, the quality with the mirror-like surface is obviously the best. The principal is the old one that two very highly polished surfaces, even metals, will stick together, so that all that is necessary is to press the p.v.c. strip on to the window and there it sticks. No adhesive is necessary and the plasticizers have nothing to do with the adhesion other than providing the requisite softness. I have had some on my office window for some months now and they seem set for good. On the other hand, there are probably limits to thickness and length of the strips to prevent them dropping off. Furthermore, it would be important to observe the effect of water vapour (humidity can be very high in closed shop windows), since penetration may result in "blowing," and also the effect of time, hot sun and cold.

* * *

Present from Germany

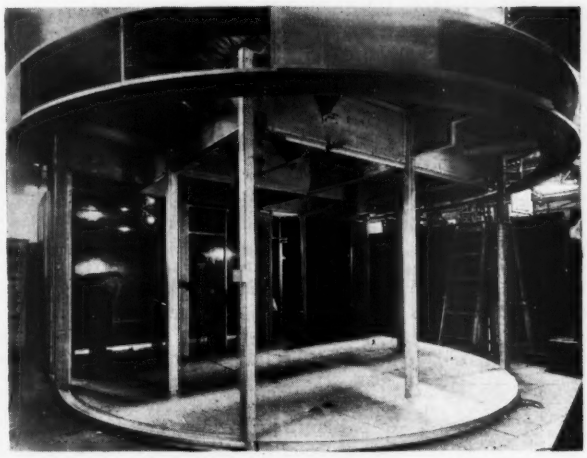
It was strange to encounter the trade mark "Pollopas" on a moulding—strange because it is now so rarely if ever mentioned in books in the English language and yet it was at one time so well known. It was derived from the name of Dr. Pollak, the discoverer of thio-urea resins. However, the name is still being used in Germany for we have seen an excellent moulding in this material (see photo. below). The device is both a night light (it contains a glass receptacle for a candle) and a very efficient heater for foods, the saucepan or other container being placed on the perforated metal sheet. The latter is cleverly fitted on top, the surface of the sheet being very slightly raised above the rim of the plastic moulding. Thus the heated saucepan does not in fact touch the plastic. The story behind its appearance in this country is interesting. It was sent to an old bedridden farmer by a German ex-prisoner of war in gratitude for the treatment he had received.

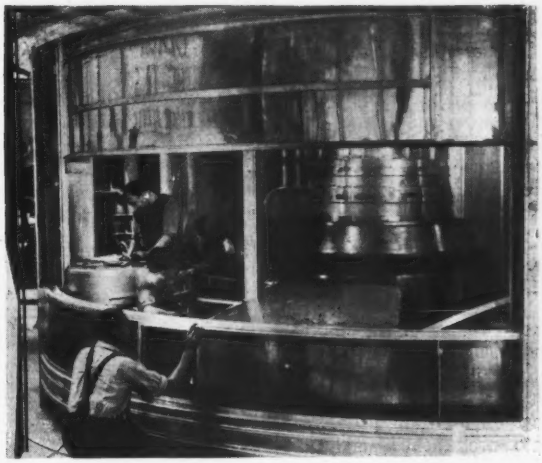
DOGSBODDY.

Modern Bookstall at Marylebone Station

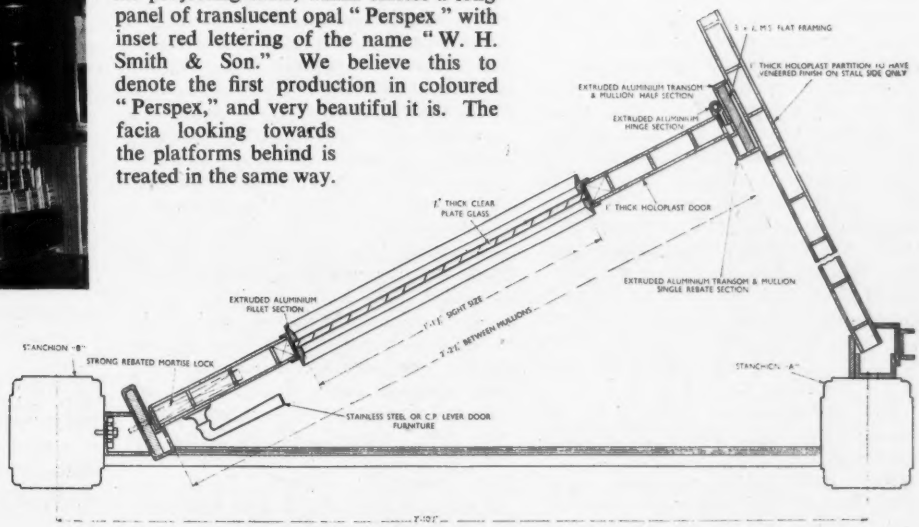
IN July, W. H. Smith and Son, Ltd., inaugurated a prototype bookstall of noteworthy design and construction, entirely of aluminium and plastics, the latter being "Holoplast" (the structural phenolic material made on the "girder" principle) and "Perspex."

Thus, for example, the roof is a light-alloy lattice structure, to the underside of which is attached a "Holoplast" ceiling. All doors are also of this very strong and attractive material and are faced with walnut veneer. Flat components installed in the rear office and the ordinary shelving, likewise, are also constructed mainly of "Holoplast."





On the left of the counter there is a circular display stand of curved "Perspex" plates, which slide in extruded aluminium channels. This material is also employed for the counter front and for racks displaying magazines. Of special interest is the projecting facia, which carries a long panel of translucent opal "Perspex" with inset red lettering of the name "W. H. Smith & Son." We believe this to denote the first production in coloured "Perspex," and very beautiful it is. The facia looking towards the platforms behind is treated in the same way.


EXTRUDED ALUMINIUM TRANSOM & MULLION HALF SECTION
EXTRUDED ALUMINIUM HINGE SECTION
THICK HOLOPLAST DOOR
EXTRUDED ALUMINIUM TRANSOM & MULLION SINGLE REBATE SECTION
EXTRUDED ALUMINIUM FILLET SECTION
STRONG REBATED MORTISE LOCK
STAINLESS STEEL OR C.P. LEVER DOOR FURNITURE

Two of our photographs show the bookstall in course of construction. (Right) Detailed cross-section of door.

Marking Processes and Media—VIII

By E. E. HALLS

In this instalment the author describes the use of cellulose enamel and lacquer finishes as marking media. Extensively used in combination with hot press marking, engraving and stencilling processes, they provide illuminated panels for radio and electrical equipment. Laboratory characteristics of suitable lacquers are included.

A COMBINATION of cellulose lacquer or enamel finishes and engraving, or hot press marking, provides a range of markings for a variety of purposes on transparent polymethyl methacrylate sheet or moulded components. This plastic is extensively used instead of glass in apparatus and instruments, because of its better characteristics in respect of clarity, ease of fabrication, dimensional closeness and resistance to mechanical shock. Further, it can be illuminated from the edge, and light can be "piped" through it around intricate paths.

The markings in this group are particularly exploited in electrical communications equipment, especially in radio apparatus and remote control equipments. The general objective is that an unobtrusive engraved marking shall be clearly visible when illuminated. The markings are of an indicative or instructional nature and may be brought out boldly against a suitable "neutral" background in either normal yellow or coloured lighting. The same marking may be revealed in one of several colours to show a different significance, such as a spot in green or red for power "off" or "on," or a number of different markings on the same panel may be brought into prominence singly or together in different colours.

The simplest example of process in this group involves the enamelling and engraving on one face of the plastic. The surface and edges of the polymethyl methacrylate sheet are cleaned by wiping over with a cloth moistened in white spirit, and then a single coat of the appropriate pigmented cellulose lacquer or enamel is applied uniformly by spray. This is dry for careful handling within 30 minutes, but 24 hours is allowed before packing or passing to engraving. The finish can readily be engraved on the usual pantographic type of engraving machine, and the cellulose finish withstands this operation without any tendency to chip, flake or peel at the edges of the characters, and without any peeling of the "centres" of characters, such as might be expected with the letters o, a, e, and with many numerals, such as 4, 6, 8 and 9.

The robustness of this type of engraved marking is illustrated by cyclic test results on a dial consisting of polymethyl methacrylate machined from sheet, finished black and engraved on one face. This showed no deterioration whatsoever after subjection to the following series of "tropical" tests:—

(a) Dry heat for 16 hours at 70-72 degrees C.
(b) Wet heat for 16 hours at 70-72 degrees C. with 100 per cent. humidity, finally cooling under these conditions to produce condensation upon the specimen.
(c) Subjection to cold at minus 40 degrees C. for six hours.
(d) Subjection to two further wet heat cycles.

No failure of the enamel finish was detectable, and no distortion occurred as might have been expected from the finish applied to one face only. Characteristics of dead matt black, semi-bright black and grey cellulose enamels used in this manner are given in Table 1; they are, in effect, quite ordinary cellulose media of good commercial grades.

Table 1.—Laboratory Characteristics of Spraying Cellulose Enamels.

Colour	Matt black	Semi-bright black	Semi-bright grey
Volatile spirit (3 hrs. @ 110° C.) per cent.	83.6	87.6	56.8
Total solids, per cent. ..	16.4	12.4	43.2
	100.0	100.0	100.0
Viscosity @ 25° C., centipoises	365	200	1100
Specific gravity @ 25° C. ..	0.901	0.902	1.115

Viewed from the reverse side, the appearance of the enamelled surfaces of these treated panels is quite bright. Sometimes this is regarded as a disadvantage, because of possible back reflection of light from the illuminating source. Consequently, some designers stipulate a preliminary coating of matting lacquer, namely, a clear colourless cellulose lacquer containing a matting agent such as magnesium stearate. This, however, is not deemed to be necessary, nor, in fact, is it regarded as advantageous, and the black or grey enamel applied direct is preferred.

When coloured lighting is required, the components are finished in black or grey on the face sides and edges, then they are engraved, and, finally, they are coloured on the reverse sides by spraying with clear coloured cellulose lacquer in the shade required. It is most important that coloured lacquers should be chosen that are really fast to light, and, in fact, to heat as well if the illuminating lamps are in close proximity to the panels. This is not an easy requirement to satisfy, but the property can be assessed by exposing sprayed samples to ultra-violet light from a quartz mercury vapour lamp. Test conditions of lamp wattage, distance of specimen from the source, and time period of exposure, are standardized. The temperature of the test is arranged to be somewhat above the maximum encountered in service. Characteristics of clear coloured cellulose lacquers are given in Table 2.

Table 2.—Laboratory Characteristics of Clear Coloured Cellulose Lacquers for Spraying.

Colour	Red	Amber	Blue	Green
Volatile spirit (3 hrs. @ 110° C.) per cent.	80.2	74.3	79.8	81.6
Total solids, per cent.	19.8	25.7	20.2	18.4
	100.0	100.0	100.0	100.0
Viscosity @ 25° C., centipoises	390	740	325	420
Specific gravity @ 25° C.	0.875	0.950	0.860	0.863

When a number of these components are mounted together, the edge enamelling safeguards against light filtering from an illuminated position to one in the "off" position. Even so, minute discontinuities in the enamel finish, for example, pin-holes, can be objectionable, and when conditions make the requirement desirable, two or three coats of the black or grey enamel are applied. An inspection test is imposed at this stage of the process, the requirement being that when the component is illuminated from the reverse side with the type of lamp to be used in service (usually 24 volt, 3 watt size), then no halo shall be seen on the front side and no spread of light shall be apparent from edges.

Again, instead of finishing the reverse side with clear-coloured lacquer, a translucent effect is required to diffuse the light from the illuminating source. The general type of medium employed for this is a lightly pigmented white cellulose enamel, which may be further diluted with the matting lacquer to give the required degree of diffusion without

Table 3.—Laboratory Characteristics of Light Diffusing Media—Matt Cellulose Lacquer and White Cellulose Enamel.

Type	Matt	Matt	White	White
Volatile spirit (3 hrs. @ 110° C.) per cent.	80.3	82.1	80.1	58.5
Total solids, per cent.	19.7	17.9	19.9	41.5
	100.0	100.0	100.0	100.0
Viscosity @ 25° C., centipoises	40	80	1850	1350
Specific gravity @ 25° C.	0.917	0.911	1.050	1.058

undue opacity. If a coloured diffusing lacquer is required, then with the clear-coloured cellulose medium can be incorporated the required amount of a white cellulose enamel to yield the desired intensity of finish.

Some matt cellulose lacquers and white enamels are given in Table 3.

Polymethyl methacrylate, in the form of panels or components from sheet, or as mouldings, have been instanced as the basis of this last method of marking, because it is usually the material concerned. It is chosen for its good clarity, and in some cases for its property of "piping" light around corners, as well as for its dimensional stability. Polystyrene responds to exactly the same "finishing" processes. The other thermoplastics (e.g., cellulose acetate and ethyl cellulose) could be similarly dealt with, but they are not so widely used because of their relative instability (dimensionally) when exposed to normal atmospheric changes of temperature and humidity.

Hot-pressed Markings and Lacquered or Enamelled Finishes

The markings applied by hot pressing using a die and paper coated with plastic-bonded pigment as the "ink," and described earlier, are particularly apt for the thermoplastic materials, especially polymethyl methacrylate, polystyrene, and the cellulose plastics. When applied in reverse to the rear side of methacrylate panels, such markings can be covered with a black or grey cellulose enamel to give neutral background, or with an enamel of contrasting colour, exactly as described in the previous section. Useful results for instructional panels or labels, as well as for decorative or advertisement effects, can thus be secured.

Dial markings having permanency under arduous conditions of wear can be obtained by hot pressing the marking on to the face side of the component and then covering with a clear, colourless cellulose lacquer by spray application. A matt lacquer can be chosen for this purpose when minimum interference from reflectivity is important.

In numerous applications, plastics using markings of this type are preferred to vitreous enamelled steel. The latter is regarded as "permanent" with respect to marking, provided that it is not subjected to mechanical shock, and that the steel base metal is properly rust-proofed. The plastics are much more amenable to fabrication processes, requirements with respect to shape, size and dimensions can be more readily satisfied, and the marking processes themselves are more easy to execute than is vitreous enamelling. Further, with due consideration to design in relation to service application, the serviceability of plastic, marked and coated by an appropriate process, can equal that of vitreous-enamelled steel, and one of its advantages is that three components (plastic, marking and lacquer film) merge and perform as one homogeneous material.

Stencilled Schematics for Control Panels

Electrical systems for remote control of services and industries have advanced much in the past 20 years. Equipment is in operation for giving a picture at a control station, and/or for actual operating or control, of rail or air traffic, railway signalling, area lighting or power distribution, factory plant operation, and other systems. Generally speaking, such equipment is operated from a "desk," and the operation of keys or switches shows the response in miniature on a control panel. The latter is a schematic or diagram representing the system or systems involved with lamps inset at the operative points, these lamps responding in accordance with the conditions obtaining, illuminating to show "live," and vice versa. The lines of the diagram will be in a range of colours representative of the variety of activities or the nature of the service or production lines represented.

A preferred base for the panel work is the thermosetting plastic, not only because something permanent and free from corrosion or other deterioration is required, but also because of its electrical insulating properties, which dispense with the need for providing insulating bushes for metal inserts, such as lamp housings, keys switches, and the like. Again, this base material is stable dimensionally under temperate climatic conditions, and the phenolic varieties are extremely stable under extreme tropical conditions, or where fluctuations of humidity are likely to cause moisture condensation. Thus, troubles from contraction and expansion, and distortion by warpage, can be avoided. Further, these materials retain their appearance and can be dusted, or finger marks washed off with soapy water.

Normally, large panels, or a number of large panels, are involved, and thermosetting resin paper laminated material is employed. Phenolic resin paper laminated with a veneer of amino resin impregnated paper (urea or melamine) is the customary choice, and in this way the face side can be of any desired colour, and permanence of colour is assured. A broken white is a widely employed colour, while a pale green of the eau de nil shade is strongly favoured because it is most restful to the eye and still provides good contrast for the various colours of the applied lines. Other colours can be, and are actually, employed, including black.

It has already been explained that for repetition work, i.e., where a large quantity of the same pattern is required, there are appropriate mass-production means of printing the marking, including the inclusion of the print as the top lamina of the sheet, and moulding it in as a permanent part of a homogeneous board. This last procedure could be applied in this case for single panels, but price or complexity of coloured lines usually precludes its adoption. The following process, which, in effect, is stencilling, is generally utilized.

The panel is completely machined with respect to size, drillings for instruments, lamps, keys, etc., and for fixing holes. It is cleaned with trichlorethylene or solvent naphtha, after which it is ready for lining. For this purpose it is coated with pure soap and covered with lead or lead/tin alloy foil of thickness from 0.010 to 0.015 in. This is rolled out flat, expelling air pockets, by means of a squeegee. Then a drawing of the diagram or schematic is fixed in position, again using the soap adhesive and squeegee technique. A draughtsman then cuts the pattern through the drawing and the metal foil, using a sharp stencil knife. The cut-out portions of the pattern are stripped off, and in this way a stencil is produced temporarily fixed in correct position to the plastic sheet. Soap is thoroughly removed from the exposed areas, using several washings with a cloth moistened with distilled water.

The pattern is sprayed in the required colours, using a small stencil gun and air-drying cellulose stencil enamels by the technique previously required. After a short period of air drying, the paper and lead stencil is peeled off, and all soap washed away. In some cases an all-over coating of clear, colourless cellulose lacquer, matt or semi-glossy, is applied.

Obviously, diagrams representing systems must be changed if the latter alter, and small panels about 1 ft. square may be more convenient to effect such changes economically. In some cases, small panels or "bricks" have been used, from 1 in. square to 5 ins. square. These can be produced relatively cheaply as mouldings in urea or melamine resin plastics. Again, a more temporary form of line can be used in these cases, and is, in fact, adopted sometimes on the larger type of panel. This uses single-sided self-adhesive plastic tape, and the most used is adhesive p.v.c. tape. The adhesive is a pure rubber/colophony resin compound.

The tape is available in a wide range of colours, and widths of $\frac{1}{8}$ in., $\frac{1}{4}$ in. and $\frac{3}{8}$ in. are the normal sizes selected. This only requires laying carefully in position, pressing firmly home, without undue stretching. Slight shrinkage in the length direction occurs in practice and has to be tolerated. This can be obviated by employing polythene tape instead of p.v.c. as the basic plastic.

(To be continued.)

International Plastics Exhibition at Oslo

NORWEGIAN industry, through its development association, the Studieselskapet for Norsk Industri, held an exhibition in Oslo (September 19 to October 2) in an effort to convince the Norwegian Government of the growing importance of the plastics industry in Norway's economic future. The exhibition was designed to give prominence to the raw materials aspect of the industry—although moulded articles from abroad were also exhibited—the main intention being to show industry and officials how the raw materials of Norway could be developed to the fullest advantage.

The moulding industry in Norway is not extensive; although it comprises some 60 firms, the majority of these are very small concerns. The total number of employees is estimated at 500. The capacity of the machinery available—compression, injection and extrusion—is approximately 1,500 tons of material per year. Total consumption for 1948 was 500 tons, of which 300 were devoted to compression moulding, the balance being coatings, extrusion, and injection moulding.

The fact that only one-third of Norway's capacity is at the moment in use is due to import restrictions, and facing the fact that these restrictions are likely to apply for some time to come, Norway is taking a realistic view of the situation by boosting the erection of plant to produce raw materials.

Two firms in Norway will soon be producing phenolic moulding powder, with an estimated capacity of 1,000 tons per year. Apart from this, large concerns such as the Norsk Hydro intend to utilize their resources for the manufacture of raw materials for the plastics industry. Already Norsk Hydro is building a plant to produce 10,000 tons of urea crystals per year. Although the majority of this will be utilized for agricultural purposes, it is understood that 10 per cent. will be available for the plastics industry. "Hefa" intends to commence the production of 1,000 tons of p.v.c. per year in 1951. Although coke has to be imported to a considerable extent, the production of p.v.c. utilizing the hydro-electric power available, is being pressed.

Norway uses electricity in industry and in the home to a much greater extent than here in England. As a result of this moulds for electrical purposes are much in demand, and it is significant to note that 60 per cent. of mouldings for these purposes are imported. The reason for this is that moulds for the production of the larger electrical components are too costly to manufacture in Norway, in view of the small number of mouldings required. This problem, it is hoped, will be largely solved by the possibility of closer co-operation between the Scandinavian countries in the exchange of mould tools.

Twelve countries were represented by over 130 exhibitors, and in the exhibition, which covers a relatively small area, it was possible to study some of the best examples of the applications of plastics on an international scale. Britain was well represented by the following:—James Anderson and Co., Ltd., Ashdowns, Ltd., Associated Resin Products, Ltd., Bakelite, Ltd., Blackfriars Engineering Co., Ltd., British Geon Ltd., BX Plastics, Ltd., Catalin, Ltd., Combined Optical Industries, Ltd., T. H. and J. Daniels, Ltd., Dowding and Doll, Ltd., Erinoid, Ltd., James Ferguson and Sons, Ltd., Geigy Company, Ltd., Holoplast, Ltd., I.C.I., Ltd., Koroseal Trading Co., Ltd., Murphy Radio, Ltd., Radio Heaters, Ltd., Redifon, Ltd., Rediweld, Ltd., Thomas de la Rue and Co., Ltd., Simco Plastics, Storeys of Lancaster, Utilex, Ltd., Vinyl Products, Ltd., and R. H. Windsor, Ltd.

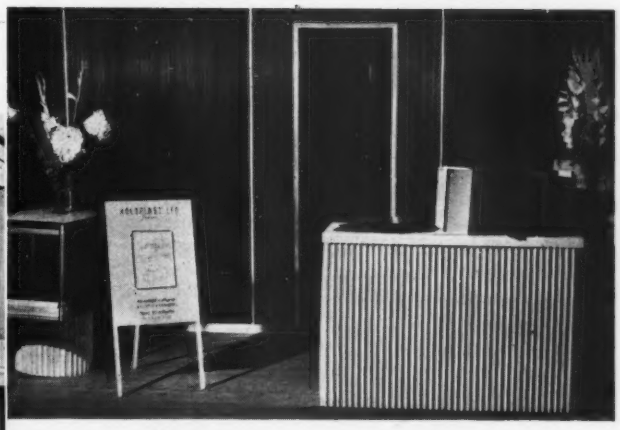
Many of these stands attracted much attention, and there is no doubt that if the Norwegian Government could be persuaded to modify its import restriction plans, British industry could do excellent trade in Norway. Despite the fact that the present trend in Norway is to develop its own resources as far as possible, it would seem that Norway, in particular, and Scandinavia, as a whole, represents a valuable market for British goods and machinery.

In a special cinema on the exhibition premises the following technical films were shown daily:—The scientific approach to better plastics—The origin and synthesis of plastics—Production and working methods of plastics—The moulding of plastics—Preparing the moulding of plastics—Press methods—Semi-automatic and manually operated pressing of complicated articles—Injection moulding—Cleaning of injection moulding machines, and Mechanical finishing of plastics.

At the conferences, held in conjunction with the exhibition, the following papers were read:—"Photoelastic Apparatus and Plastics" (C. Mylonas Aero Research, Ltd.); "The Scientific Background of High Polymer Research and its Implications" (A. J. Stavermann, Kunststoffeninstituut, Delft); "Synthetics in Paint Industry" (H. R. Fleck); "Properties and Applications of Melamine Resins" (Axel Heyman, Stockholms Superfosfat Fabriks A/B); "Some of the Relationships between the Mechanical Properties and Molecular Structure of Plastics" (S. Ore, A/S Askim Gummivarefabrik); "Fundamentals of Protein Research for the Plastics Industry" (E. M. Petri, Kunststoffeninstituut, Delft); "The Use of Polythene" (A. Renfrew, I.C.I. Plastics Division); "Welding and Fabrication of Polythene" (G. Haim, Rediweld, Ltd.); "Post-forming Laminates" (J. Hudson, Bakelite, Ltd.).

International Plastics Exhibition at Oslo

(Above) BX Plastics Ltd. exhibited "Bexoid" sheet, moulding powders, etc.



(Above) Holoplast Ltd. demonstrated some uses of their "girder" structured materials.

(Above) Imperial Chemical Industries Ltd., Plastics Division.

(Above) T. H. and J. Daniels Ltd. showed machinery for compression moulding.

(Left) Plastics Research Institute, T.N.D., Delft, Holland.

(Left) Bakelite Ltd. showed resins, moulding materials and laminates.

(Right) R. H. Windsor Ltd. exhibited one of their injection moulding machines.

L

World's Industry Employs Plastics

GENERAL ENGINEERING

Graphite - filled nylon has been found useful as dry bearing. "Nylatron G." graphite - filled nylon (produced by Polymer Corp., Reading, Pa., U.S.A.) can be used for cams, cam followers, gears, washers, oil seals, valve and pump packing. ("Machine Design," 1949/Aug./157.)

Driving belts.—The "Miraclo" belt is produced from nylon ribbon and chrome leather. The nylon is specially stretchless, having a tensile strength of about 8 tons/sq. in. The belt is said to be suitable for high-ratio drives, even up to 20 to 1, and for speeds exceeding 10,000 ft./min. The "Meteor" belt has a nylon tension member and chrome leather face, and is available as an endless belt. Both belts are supplied by Stephans Belting Co., Snow Hill, Birmingham, 4. ("Machinist," 1949/Sept. 3/692.)

No-bounce hammer.—Between the smooth cellulose acetate (Tenite) tips is a hollow metal head filled with steel grit. As the tip is lowered the charge follows, practically eliminating recoil. The producer is Tahlen Metal Industries, Ltd., 586, E. Hastings Street, Vancouver, B.C. ("Modern Machine Shop," 1949/July/298.)

Primer for aluminium.—C. St. John recommended as primer for aluminium, a formulation of vinyl-butyral resin, pigmented with zinc chromate, and thinned with a solution of isopropyl alcohol, butyl alcohol and phosphoric acid, produced by Permanente Metals Corp. ("Products Finishing," 1949/June/106.)

Shipbuilding.—Short illustrated discussion on the use of plastics in the construction of boats, for bearings and the interior of vessels. ("Engineers' Digest," 1949/Aug./281.)

Tool handle.—An aluminium sander intended for a variety of buffing, sanding and polishing operations is provided with a plastic handle of cellulose acetate, which is said to be unique for such heavy-duty electrical tools. ("Materials and Methods," 1949/Aug./67.)

Conveyor rollers.—In lightweight plastic, conveyor rollers (Alvey Conveyor Mfg. Co., St. Louis, U.S.A.), have been combined with an aluminium or magnesium frame instead of the all-steel construction used previously. ("Product Engineering," 1949/Aug./102.)

Honeycomb sandwich structure.—Composite materials of thin-gauge, high-strength skins separated by a low-density stabilizing medium have structural advantages where high strength-weight ratios are needed. H. C. Engel and T. P. Pajah discuss the physical properties of various honeycomb cores in detail. ("Product Engineering," 1949/Aug./81.)

Dynamic properties.—N. F. Astbury refers to the marked similarity between mechanical behaviour of plastics and the electrical behaviour of certain dielectrics, and derives from this a mechanical-stress-strain relationship for plastics. ("Proc. Royal Soc." A., 1949/**196**/92.)

Weathering.—The National Bureau of Standards, U.S.A., recently undertook an investigation to determine the effects of outdoor weathering, accelerated weathering and accelerated service conditions on the weight, dimensions and flexural properties of phenolic and unsaturated polyester plastics. Asbestos-fabric phenolic, laminates and glass-fabric unsaturated-polyester laminates, proved to be the most resistant materials tested. ("Chemical Age," 1949/Aug. 6/186.)

Compressed woods.—A. Dasoudil reports on tensile - compression tests under pulsating load on compressed solid and laminated wood treated by the "Lignostone" process. Both solid and laminated woods showed a good pulsating strength in relation to their static strength; this ratio was lower for a laminate with fibres crossing in neighboured layers. ("V.D.I. - Zeitschrift," 1949/**91**/85.)

Young's modulus.—H. W. Moll and W. J. Lefevre investigated the variations of Young's modulus with temperature by means of a laboratory apparatus. Data for a number of plastics have been compared with impact and service data. ("Ind. Eng. Chem.," 1948/Nov./2170.)

Impact resistance.—Charpy and flexure tests have been made by H. M. Quackenbos at speeds up to 4 ft./sec., but the effect of speed was found to be slight in practical impact range (4 to 11 ft./sec.). Possible impact-testing methods for all types of plastics are considered and two tests recommended. Discussion. (A.S.T.M. Bulletin, 1949/July/56.)

Plasticizers and abrasion resistance.—Using the redesigned Schiefer abrasion testing machine, small cylinders of acetate butyrate containing various percentages of dibutyl sebacate were tested for rate of abrasion. The rate increased proportionally to the percentage of plasticizer present. ("J. Research Nat. Bureau of Standards," 1949/May/481.)

Flexure testing.—J. W. Westwater investigated the factors influencing the flexural properties of plastics from the theoretical and the experimental side. Rectangular beams, simply supported and loaded at mid-span were investigated. Two phenolic laminates represented stiff plastics, cellulose acetate, and vulcanized fibres were used as ductile materials. A considerable variability in physical properties of commercial laminates was found. (A.S.T.M. Preprint No. 87, 1949.)

Injection moulding.—A single shot injection moulding machine by Watson-Stillman Co., Roselle, N.J., is said to increase materially the size range of products which can be injection moulded in one piece from thermoplastics. An automatic stuffing device increases the rated capacity of this 48 oz. machine from 40 to 50 per cent. ("Machinery" (N.Y.), 1949/Mar./208.)

Compression and transfer moulds.—Features and applications of the basic types of moulds, and factors influencing plastic mould design, are discussed from the practice of the Westinghouse Electric Corporation by J. J. Johnescu in an illustrated article. ("Machinery" (N.Y.), 1949/June/173.)

Transfer moulding.—K. Schön describes a special attachment for the usual hydraulic presses to perform transfer moulding of small parts in phenol resins. ("Kunststoffe," 1949/July/162.)

Injection moulding.—New injection moulding machine, with independent motor drive and pump, for a 2 oz. charge gives injection pressure of 1,200 kg./sq. cm. and closing pressure of 36 tons; can be worked for up to six charges per minute. ("Kunststoffe," 1949/Apr./98.)

Moulds.—W. Bucksch deals with tolerances for the production of moulds. Besides the tolerances for the shrinking of the plastic material which may be found by calculation, tolerances have to be fixed for production of mould, wear of mould and variations in production. The following percentages of the total tolerance are suggested: Production of mould 30 per cent., wear of mould 30 per cent., variations in production 40 per cent. ("Kunststoffe," 1949/June/135.)

Machining of moulded plastics.—This subject is treated by P. O. Campo in a series of articles; the present instalment deals with thermoplastics. ("La Machine Moderne," 1949/June/10.)

Plywood metal laminate.—A description of the works of Venesta, Ltd., has recently been published. The firm is producing "Plymax" a metal-faced plywood, and "Vendura," an aluminium veneered wood glued by the "Redux" process. ("Scope," 1949/June/70.)

CHEMICAL

New polymer. — "Kel-F Thermoplastic" is a polymer of trifluorochlorine thylene, four-fifths of its weight being made up of fluorine and chlorine. In its natural state it is colourless and transparent, but it can be blended with solid fillers and colouring agents. Closely related to the fluorocarbon family, it was developed during the war in relation to the uranium diffusion plant at Oak Ridge. The producer is M. W. Kellog Chemical Mfg. Co., P.O. Box 149, Jersey City 3, N.Y. ("Nucleonics," 1949/July/80.)

Phenol-alcohol.—E. Ziegler and G. Zigeuner make a contribution to the investigation of the individual reactions which lead to the constitution of phenolic resins. ("Kunststoffe," 1949/Aug./191.)

Modified alkyd resins.—Severe tests proved that alkyd enamels exhibit good resistance to water, chemicals and gasoline. In a symposium on alkyd resins the viewpoint was expressed that oil-modified alkyd resins will be used more widely in the finishing industry. ("Products Finishing," 1949/Aug./64.)

Polymer chemistry.—At the VDI Convention at Dusseldorf in September, 1949, A. Hoechtlen, Leverkusen, reported on progress in the chemistry of plastics during the past 10 to 15 years, referring in particular to the production of polymerized materials of excellent properties, such as polyamides and polyesters, which are of importance for fibrous materials. He also referred to the silicones and the vinyl-fluorene products. P. Pinten, Troisdorf, discussed the use of plastics in the various branches of engineering and for domestic purposes. ("VDI Zeitschrift," 1949/**94**/360.)

ELECTRICAL

Television housing. — A one-piece moulding of phenolic plastic houses the chassis of the television set now being manufactured by Admiral Corporation, Chicago. ("Products Engineering," 1949/July/105.)

Conductive plastics.—Outstanding characteristic of the "Markite" material is that it has substantial and predeterminable electric conductivities. Thermosetting, thermoplastic and elastomeric variants have been produced. Various new and old uses open up for these materials, amongst them the moulding of three-dimensional circuits. ("J. Electrochem. Soc.," 1949/Aug./36 C.)

Welding of plastics.—A general survey of the application of high-frequency heating for welding thermoplastics is given by J. C. Heath. Equipment, methods and possibilities of technique are reviewed. ("Machinist," 1949/June 25/303, and 1949/July 2/335.)

Transformer moulding.—The exterior casing and the coil insulation of a new instrument transformer by General Electric Co. are a single-structure butyl moulding, several operations in transformer manufacture thus being eliminated. ("Product Engineering," 1949/July/104.)

MISCELLANEOUS

Silicones. — H. Kittel gives a comprehensive survey on the silicones, stressing their importance as lacquers, use of which does not yet appear to be fully developed. ("Metalloberfläche," 1949/Aug./156.)

American plastics industry. — H. Saechtling and E. Roemer give a statistical survey of the American plastics industry in general and of its sections in particular. ("Kunststoffe," 1949/Apr./94.)

Adhesive strength.—A number of adhesives ranging from cellulose nitrate, polyvinyl acetate and casein to neoprene have been bonded to steel, aluminium, glass, etc., and the physical values of the bonds have been determined. Highest shear strength was between aluminium alloy and polyvinyl acetate; highest tensile adhesion between steel and polyvinyl acetate. ("Materials and Methods," 1949/July/83.)

Plastics and rubber.—The Gemeinschaft Deutscher Chemiker arranged a meeting in Munich, September 23, when papers were presented by K. Wolf (Ludwigshafen) on inter-relations between constitution and physical behaviour of highly polymerized substances, in particular with polyesters; F. Wuerstlin (Ludwigshafen) on dielectric measurements on linear highly polymerized materials; and L. Horner (Frankfurt) on the acceleration of the peroxide decay through amines. ("Kunststoffe," 1949/Aug./204.)

Standards.—A.S.T.M. Committee on Plastics deals with nomenclature and definitions, permanence, etc. (A.S.T.M. Bulletin, 1949/July/23.)

Acrylic moulding powder.—New heat-resistant acrylic composition can be moulded at cylinder pressures of 360 to 490 degrees F. about 50 degrees F. higher than usual acrylic powders. The new powder is more fluid at a given moulding temperature than former compositions. ("Autom. Industries," 1949/May/72.)

Lenses for Ansco reflex camera viewfinders are injection moulded from a specially formulated acrylic resin by Brilhart, Ltd., N.Y. A four-cavity, thermostatically controlled mould produces lenses 2¼ ins. square and ⅛ in. thick on an automatic seven-minute cycle. ("Industrie des Plastiques Modernes," 1949/Sept./27.)

Coating material produced by L. Sonneborn Sons, Inc., 88, Lexington Avenue, N.Y., 11, is said to be the toughest plastic so far made. The phenolic material is applied by dipping, brushing or spraying, and air dries in about 4 hours. Its relatively high price is offset by its durability. ("Wire and Wire Products," 1949/Aug./709.)

Weight loss of plastic films and sheets on heating has been investigated by M. E. Marks. The apparatus consists of multiple chambers fed at a controlled rate with clean, dry, preheated air. Experimental results and a description of the methods are given. (A.S.T.M. Bulletin, 1949/July/52.)

Phenolic laminates.—I. L. Feeley and C. J. Rapp describe the fabricating methods for producing cabinets in wood-base high-pressure laminate. ("Materials and Methods," 1949/July/54.)

Heat-setting of thermoplastics.—An American manufacturer has developed a gas-fired totally enclosed heat-setting machine for nylon, acetate, acrylics and similar products. Speed, temperature and exposure time are controlled accurately. ("Textile World," 1949/Apr./150.)

Scales.—The Toledo Guardian 70 Commercial Scale (Toledo Scale Co., Toledo, Ohio) has a three-piece "Plaskon" housing. An acrylic plastic light track is used to "pipe" the light to the weight indication window. ("Machine Design," 1949/Aug./148.)

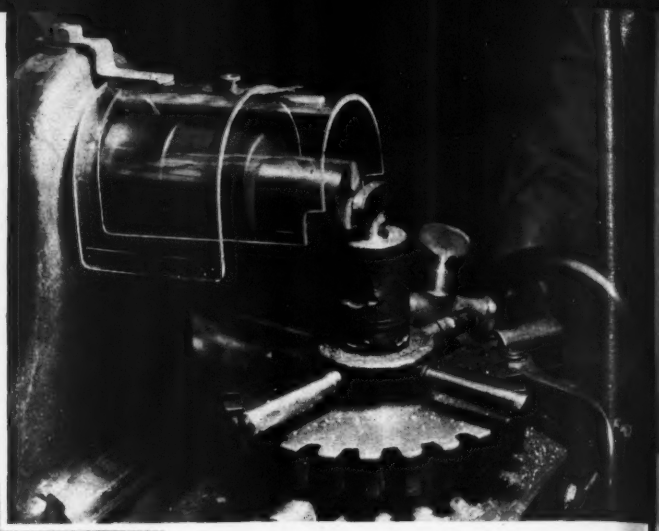
Lining for drums and tanks of "Cycloflex" PC-M, made by Poly-Cydo Products Co., Cleveland, Ohio, provides a rugged, chemically inert membrane and high resistance to corrosion and chemical attack. A white interlining allows foreign matter to be easily detected, but a high-gloss black lining is also supplied. Both linings withstand great fluctuations in temperatures. ("Machinery," (N.Y.), 1949/July/209.)

Fast-curing phenolic moulding powders, announced by General Electric Co., have low specific gravity of 1.37, giving higher number of components per pound of powder. ("Materials and Methods," 1949/June/96.)

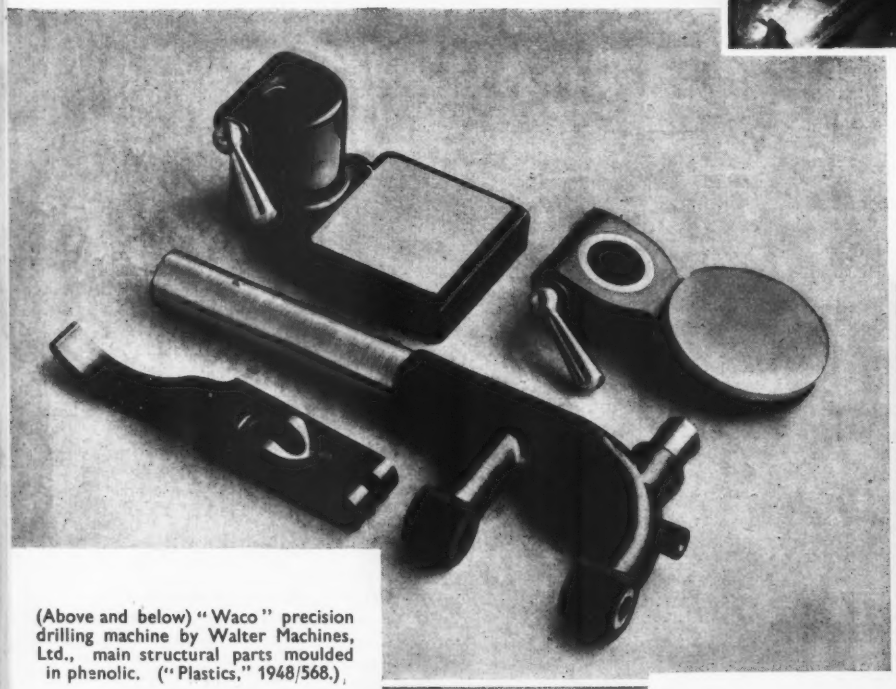
PLASTICS
IN THE SERVICE OF MAN

A pictorial review of high-quality units moulded or otherwise fabricated in Great Britain . . .

4. Engineering Components and Tools

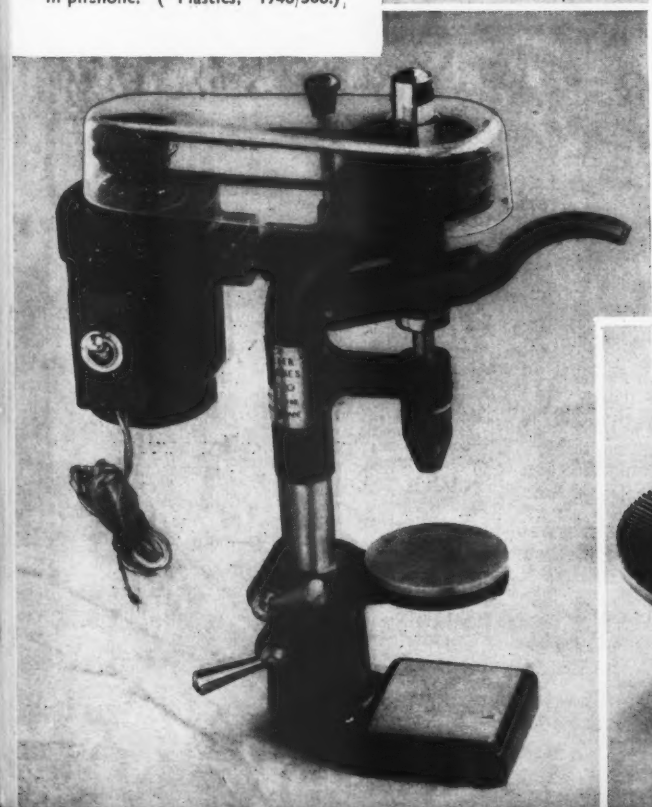


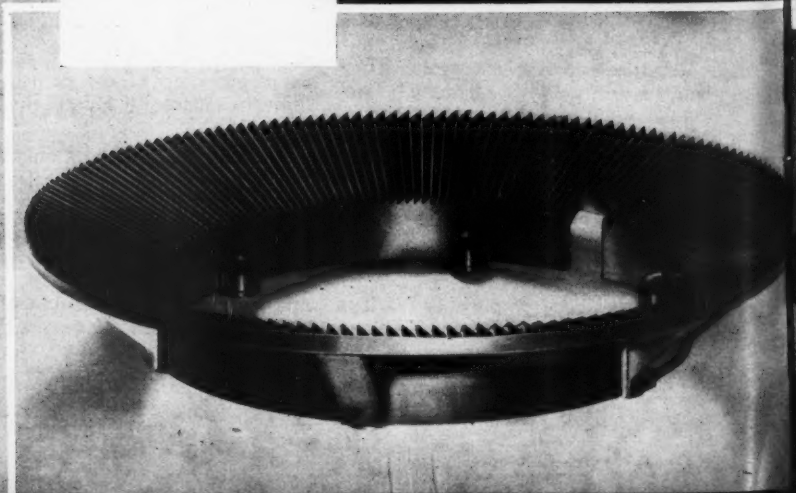
(Above and below) "Perspex" guards by Silvaflame Co., Ltd., as used on bench drilling machine and on "Eley" iron and brass head assembling machine. (Courtesy, Imperial Chemical Industries Ltd., Plastics Division.) ("Plastics," 1948/340.)

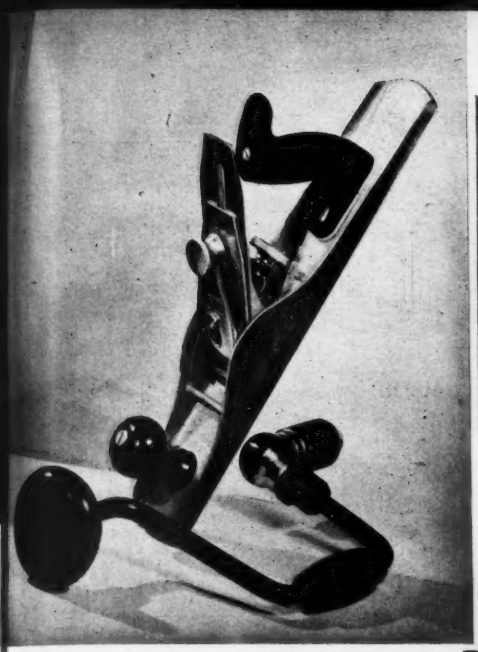


(Above and below) "Waco" precision drilling machine by Walter Machines, Ltd., main structural parts moulded in phenolic. ("Plastics," 1948/568.)

(Below) Grid ring, 14½-in. diameter, with 180 radiating teeth, moulded in phenolic by British Moulded Plastics, Ltd., for Mellor Bromley and Co., Ltd., air-conditioning engineers, Leicester.





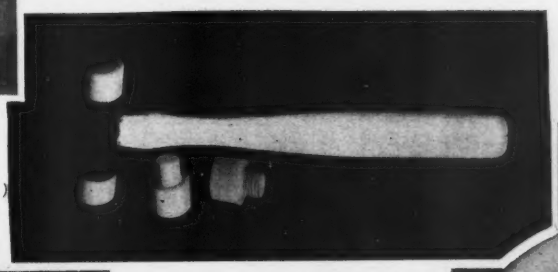


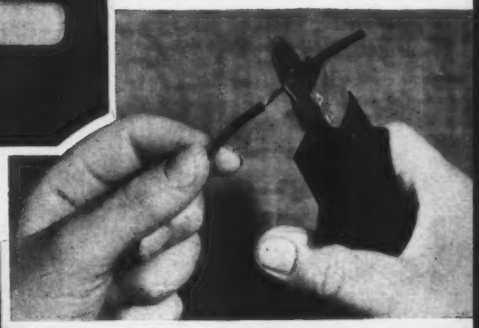
(Above) Handles for tools made by Anglo-Scottish Tool Co., Ltd., are moulded in "Bakelite" material.

(Below) Hand-drill incorporating phenolic mouldings.

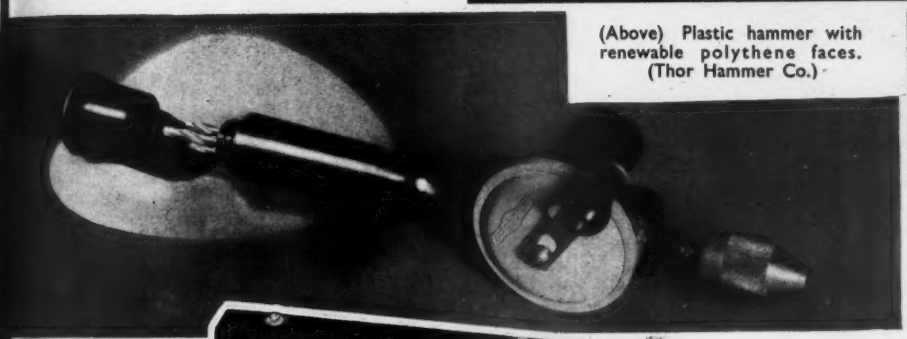
(Above) Electrode-holder for electric welding: handle, guard and insulated parts made of "Tufnol."

(Above) Protective packaging for machine tools, by Birmingham Tool and Gauge Co., Ltd. ("Plastics," 1948/225.)





(Above) Plastic hammer with renewable polythene faces. (Thor Hammer Co.)

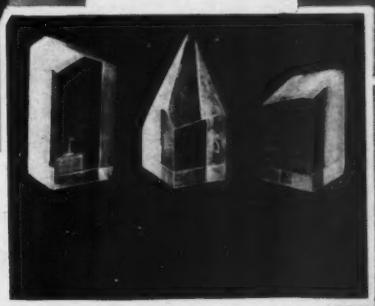


(Above) Electrically heated pliers for stripping the insulation from plastic-covered wires (Standard Telephones and Cables, Ltd.): handles moulded in "Bakelite" fabric material by E. Shipton and Co., Ltd. ("Plastics," 1949/215.)

(Below) Roofing gauge for the building trade. ("Plastics," 1947/379.)

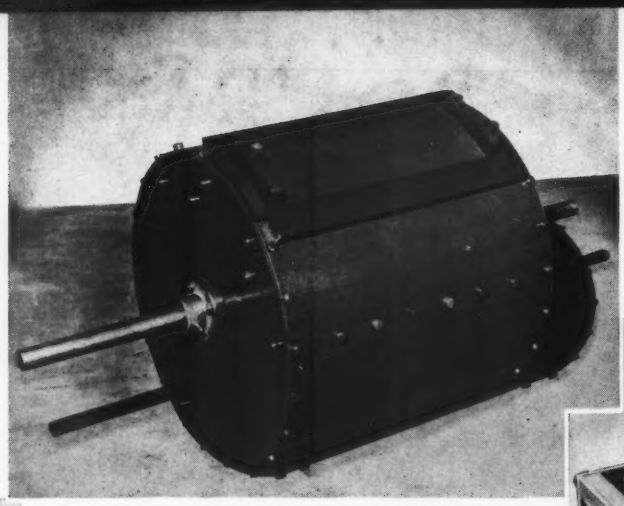
(Left) Precision gauges made by Coventry Gauge and Tool Co., Ltd., are protected against damage in a box moulded in "Bakelite."

(Left) Stud welding gun (Crompton Parkinson, Ltd.): body moulded in high strength "Bakelite" material (with metal inserts) by Ashdowns, Ltd. ("Plastics," 1949/120.)



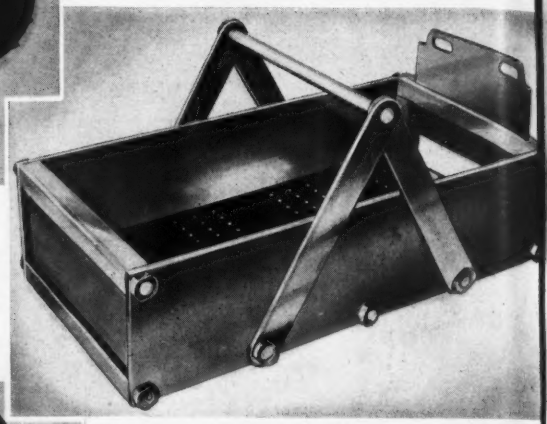
(Above) Plastic replicas of diamond tools. ("Plastics," 1949/Mar./156.)

(Right) Micrometer case, moulded in "Scarab" by Illingworths (Plastics), Ltd. ("Plastics," 1949/153.)

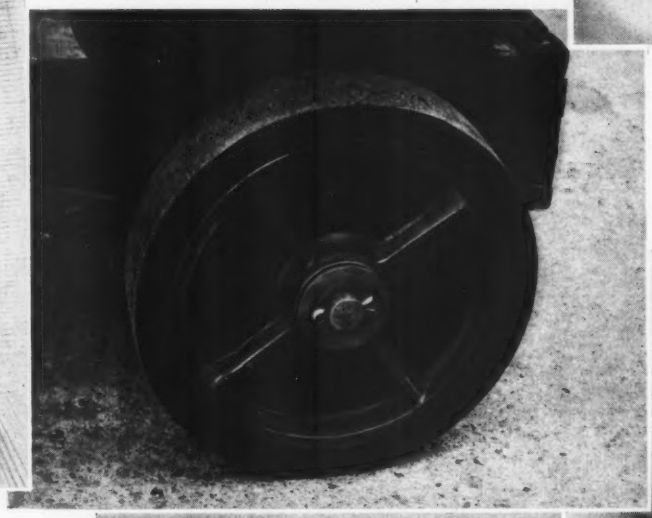


(Left) Rotating electro-plating barrel, 20 in. diam. × 2 ft. long, excepting the electrodes, made throughout of "Paxolin" by The Micanite and Insulators Co., Ltd.

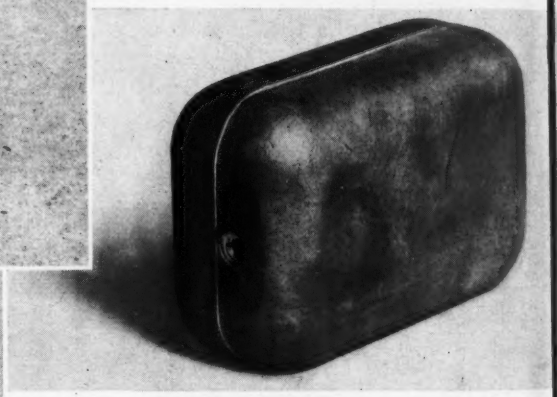
(Below) Electro-plating jig, 3 ft. 6 ins. × 1 ft. 3 ins., coated with "Vinselm" hard p.v.c. compound, as made by Creators Ltd. for Electro Chemical Engineering Co., Ltd.



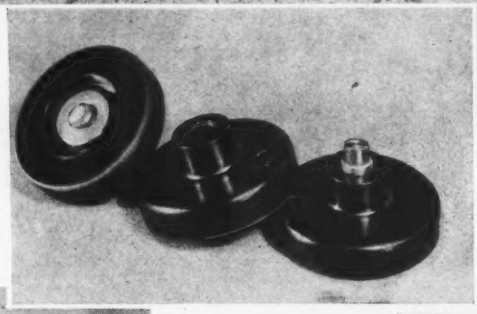
(Below) Wheel tyre of fabric "Paxolin" for industrial trucks; these tyres have long life and reduce noise when running on rough surfaces. (The Micanite and Insulators Co., Ltd.)



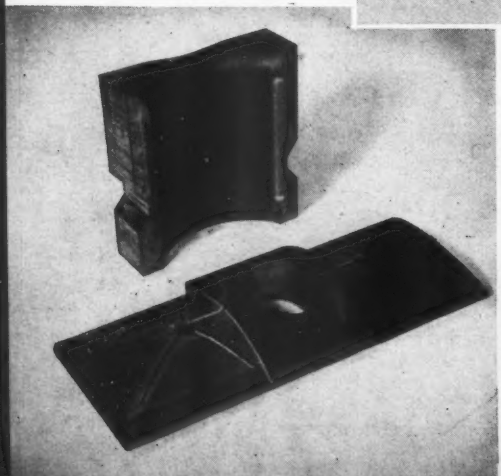
(Above) Etch basket constructed entirely of "Tufnol," for use in the electro-plating industry. (Tufnol, Ltd.)



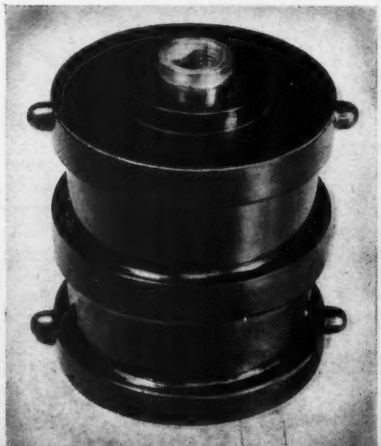
(Right) Phenolic roller bearings by Moulded Products Ltd., for use on smooth running drawers of steel cabinets. ("Plastics," 1948/594.)



(Above) Float, in expanded rubber, as used for operation of cistern valve. ("Plastics," 1947/4.)



(Left) Bearing block and coupling pad of fabric "Paxolin." (The Micanite and Insulators Co., Ltd.)

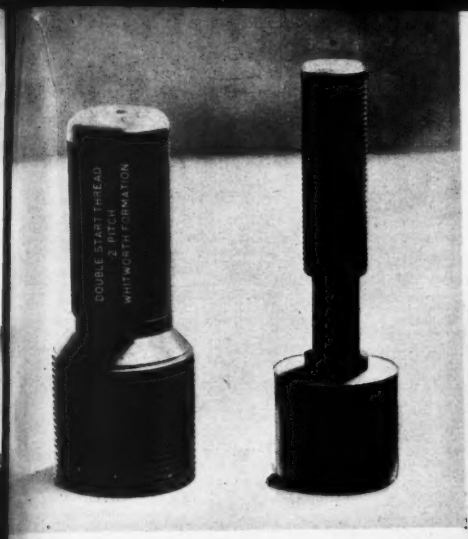


(Right) Driving drum for ticket issuing machine, moulded for the Bell Punch Co., Ltd., by Crystalate Ltd.

(Above) Handle for electric welding equipment. (Crystalate Ltd.)

(Below) Safety jug of welded polythene (capacity 3 gallons) as used for carrying industrial acids. (Redifon, Ltd.)

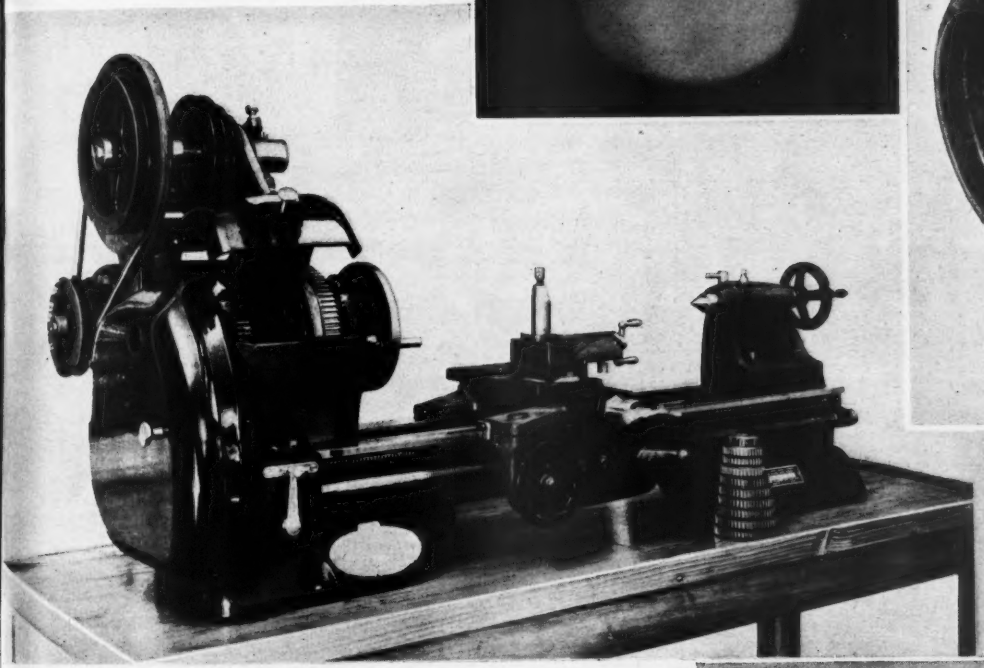
(Above) Handwheel for office machinery equipment (Addressograph Multigraph, Ltd.) moulded by Crystalate, Ltd.



(Above) Thread-pitch gauge and plug gauge machined from synthetic resin bonded fabric board by J. Burns, Ltd.

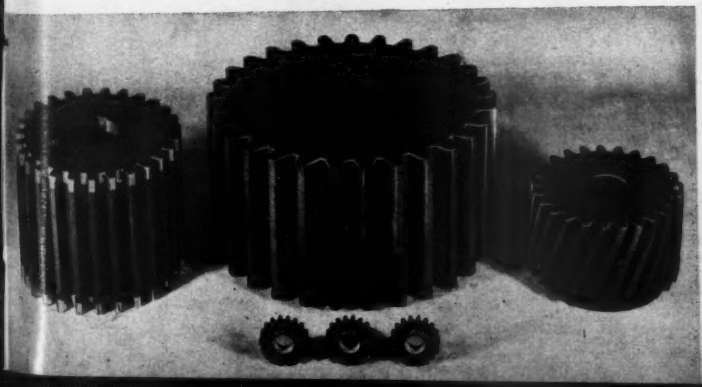
(Above) Handle for mechanical pick, moulded in "Texolex" (reinforced plastic) by The Bushing Co., Ltd.

(Below) "Formapex" liners and thrust rings for roll-neck bearings at steel and non-ferrous metal rolling mills. (Ioco, Ltd.)



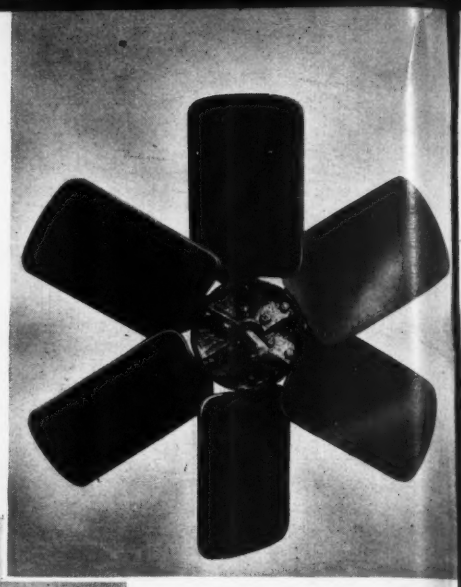
(Above) C.V.A. bench lathe, with plastic belt guard, pulley wheels, handles and knobs moulded by British Moulded Plastics, Ltd.

(Below) "Formapex" silent gears for industrial motor drives where elimination of noise is of primary importance, e.g. underground haulage gear at collieries and in textile mills. (Ioco, Ltd.)

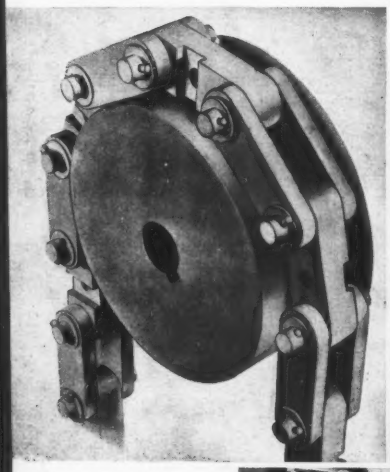


(Above) Insulating sheaths of p.v.c. for electricians' pliers. (J. F. Kenure, Ltd.)

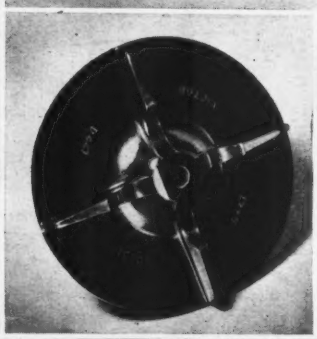
(Right) The blades of this fan, 4 ft. 6 ins. diameter, operating at 450 r.p.m., are made of "Tufnol."



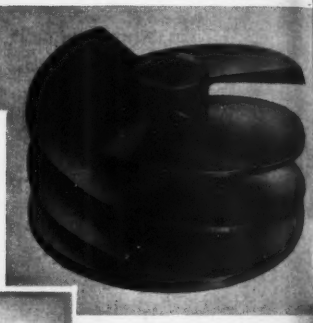
(Below) The links for this conveyor chain are moulded in "Bakelite," by Thomas De La Rue and Co., Ltd., Plastics Division. (Courtesy, Redler Conveyors, Ltd.)



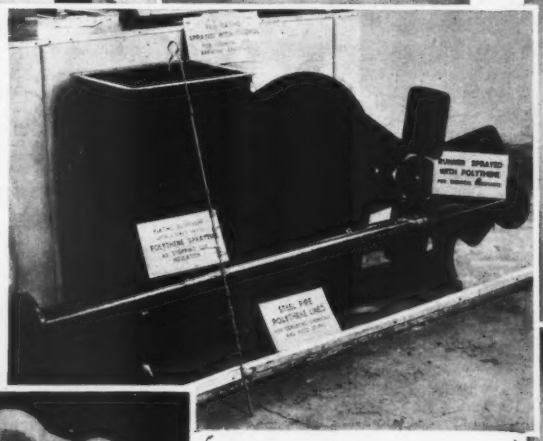
(Above) Jockey wheel and part of chain for operating in boiling 1 per cent. hydrochloric acid. (Tufnol Ltd.)



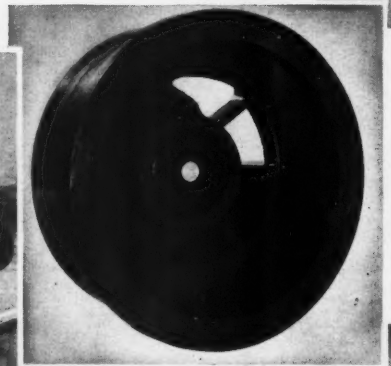
(Below) Petrol pump impeller, 1⅝ ins. diameter, operating at 17,000 r.p.m., moulded in "Bakelite," by Merriott Mouldings, Ltd. (Courtesy, Bakelite, Ltd.)



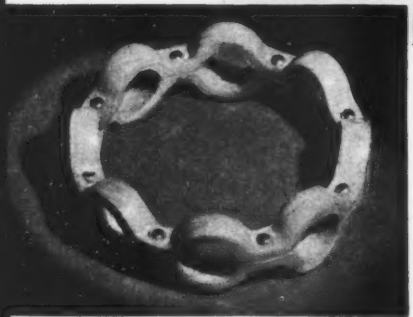
(Left) Moulding for "Victor" fan, by Lustroid, Ltd.



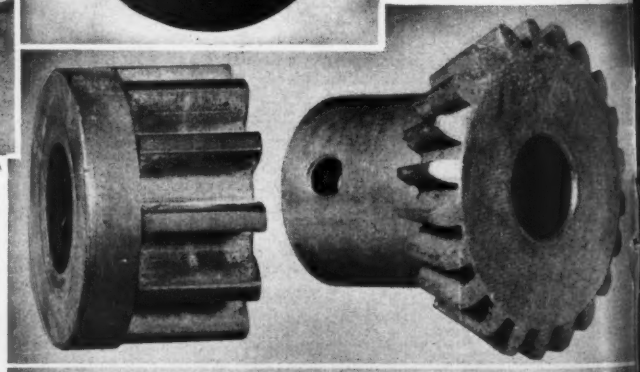
(Right) Flame-sprayed polythene coatings for the corrosion protection of chemical and allied industrial plant. (Schori Metallising Process, Ltd.)



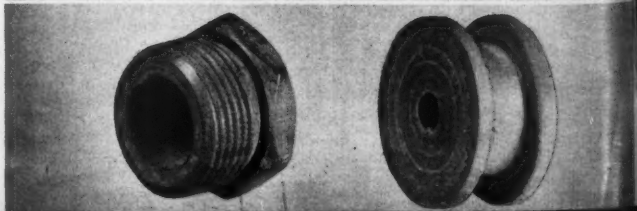
(Left) Piston chamber for water meter, moulded by United Ebonite and Lorival, Ltd. ("Plastics," 1949/Apr./177.)



(Above) Ball-bearing cage of phenolic laminate, the two halves being riveted together. (Courtesy, Skefco Ball Bearing Co., Ltd.)



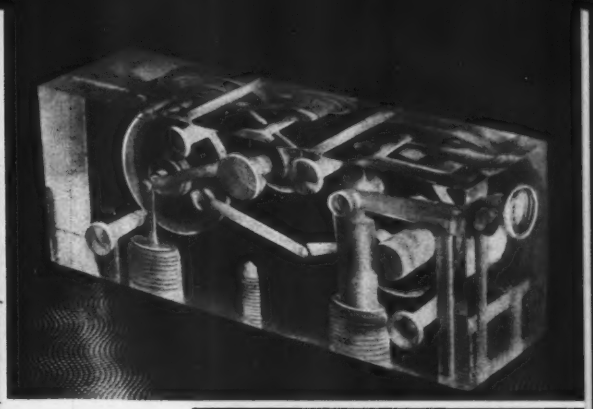
(Right) Gear, keyed to metal collar, and (extreme right) bevel gear and bush, both in fabric laminated material. (Mica Products, Ltd.)



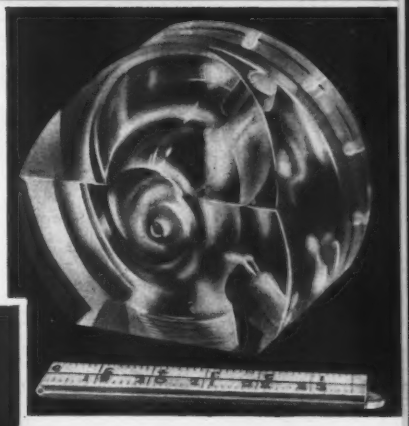
(Right) Gland, and (extreme right) pulley, the former machined from resin-bonded fabric sheet and the latter from resin-bonded paper tube. (Mica Products, Ltd.)

(Below) Plastic baseplate for industrial refrigeration motor compressor (G. and J. Weir Ltd.) moulded by Aeroplastics Ltd.; weight 31 lb., overall dimensions 31 ins. × 20 ins. ("Plastics," 1949/July/357.)

(Above) Model of "Isothermos" railway truck bearing made in transparent methyl methacrylate. ("Plastics," 1947/545.)

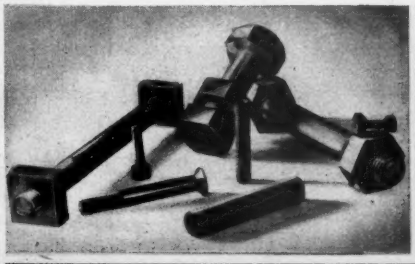


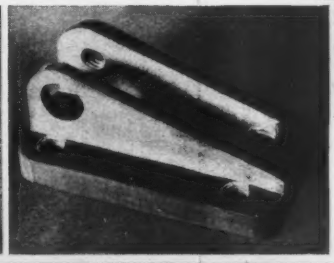
(Above) Demonstration gas distribution unit of intricate design machined from block "Catalin." ("Plastics," 1941/195.)



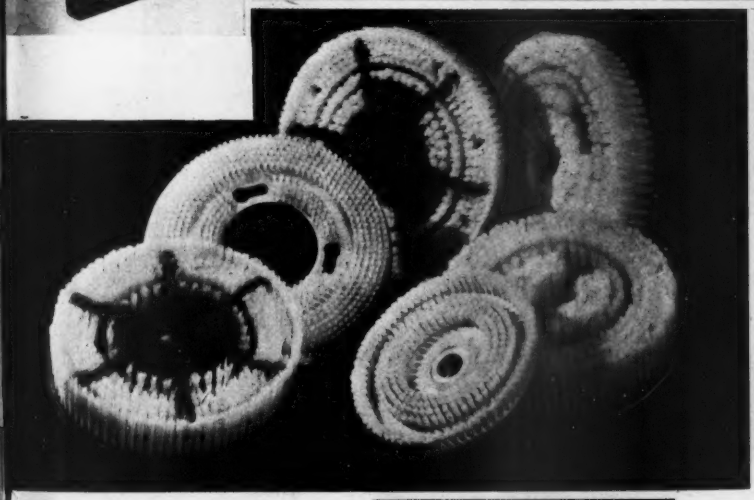
(Below) Nuts and bolts made of "Tufnol," for use in corrosive situations. (Tufnol, Ltd.)

(Right) Demonstration water-cooler pump, made by J. Burns, Ltd. for Rolls-Royce Ltd. ("Plastics," 1941/195.)





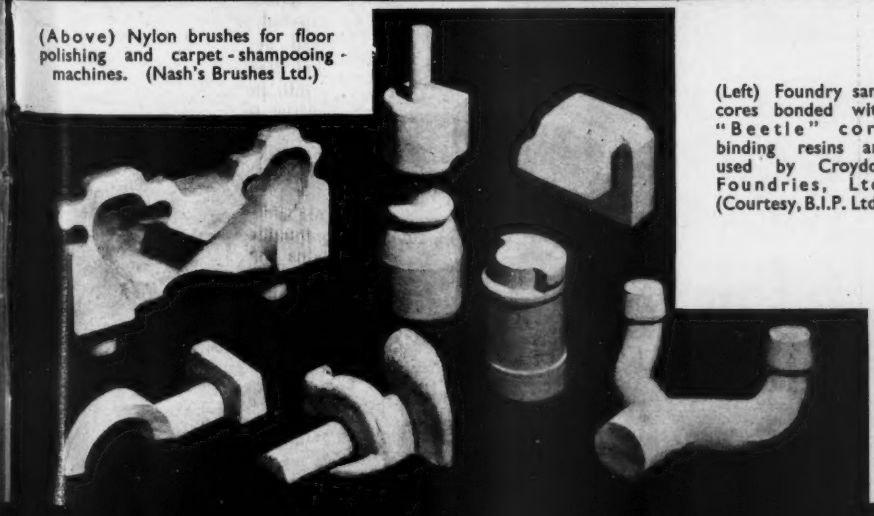
(Left) Aircraft hinge block machined from fabric "Delaron." (Thomas De La Rue and Co., Ltd., Plastics Division.)



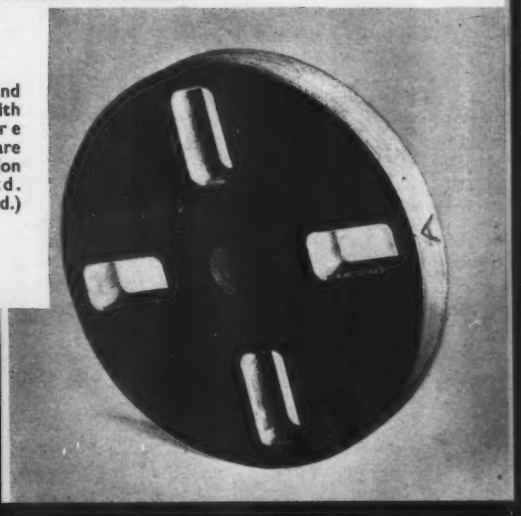
(Above) Nylon brushes by Webb (Jaratt and Co.), Ltd. for fruit pulping machines. ("Plastics," 1949/May/239.)

(Below) Engine coupling in fabric "Delaron." (Thomas De La Rue and Co., Ltd., Plastics Division.)

(Above) Nylon brushes for floor polishing and carpet-shampooing machines. (Nash's Brushes Ltd.)



(Left) Foundry sand cores bonded with "Beetle" core binding resins are used by Croydon Foundries, Ltd. (Courtesy, B.I.P. Ltd.)



Calculator Keytops Moulded Automatically in Two Colours

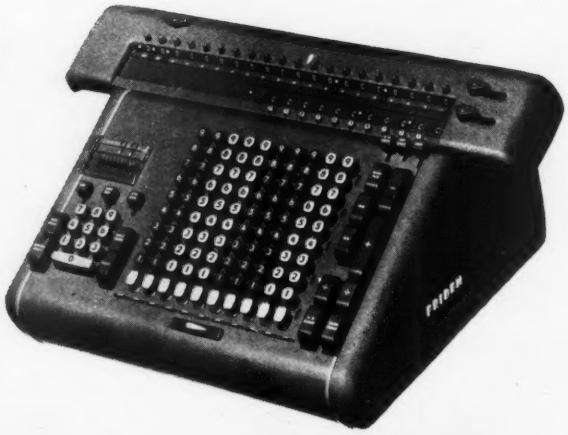


Fig. 1.—Friden calculating machine (latest model) showing two-colour keytops.

IN the San Leandro, California, plant of the Friden Calculating Machine Co., an H-P-M injection machine automatically moulds two-colour calculator keytops, thereby eliminating tedious hand work in the production of these parts. The automatic two-colour moulding machine which was designed and built by the Hydraulic Press Mfg. Co., Mount Gilead, Ohio, U.S.A., is equipped with a vertical downward acting hydraulic mould clamp and two 4-oz. capacity opposed horizontal injection units. A unique four-station indexing mould permits both colour injection, cooling and stripping operations to be performed simultaneously.

In developing the automatic mould, it was decided to mould the keytop shells first, rather than mould the character cores first, since great difficulty would occur in trying to hold these cores in the correct position for moulding the keytop shells around them.

The first injection "shot" produces the keytop shells, which contain the impressions of the characters or numerals with cross bridging for supporting the centres of numerals such as 9's, 8's, etc.

As the vertical mould clamp raises and lowers, it indexes the carrier plate (containing the keytop shells) 90 degrees in a clockwise position to a cooling station. On the next cycle, this carrier plate is automatically indexed to a second mould, where the core material of contrasting colour is injected into the shells, so forming the filled-in portion of figures or letters. While the second colour is being injected, another set of shells is being produced at the first injection station. The final press cycle indexes the finished keytops into position for stripping them from the carrier plate. The complete moulding cycle takes 1 min. and 15 secs. for the control keytops (Fig. 2) and 45 secs. for the numeral keytops (Fig. 3).

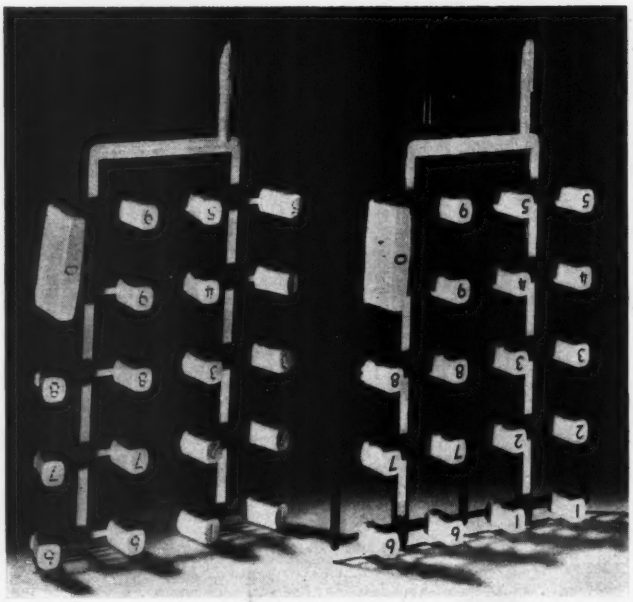


Fig. 2 (below).—Front and rear views of complete shot of finished control keytops, showing two-colour gating.

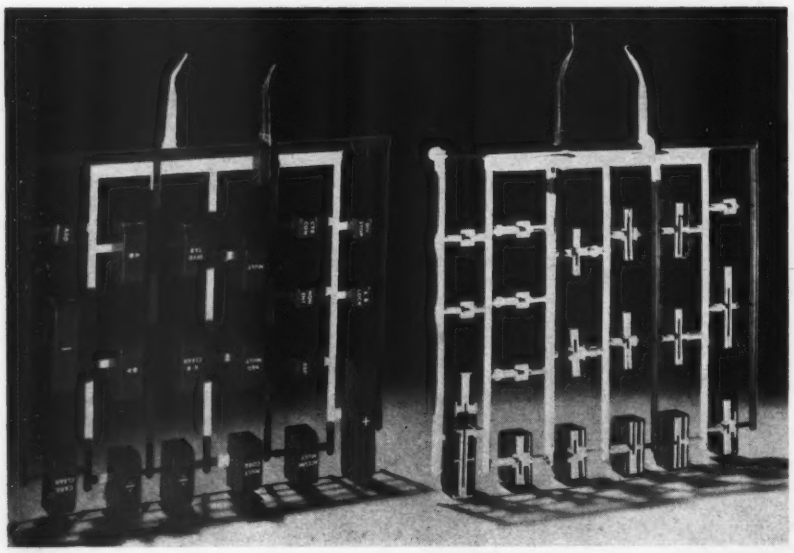
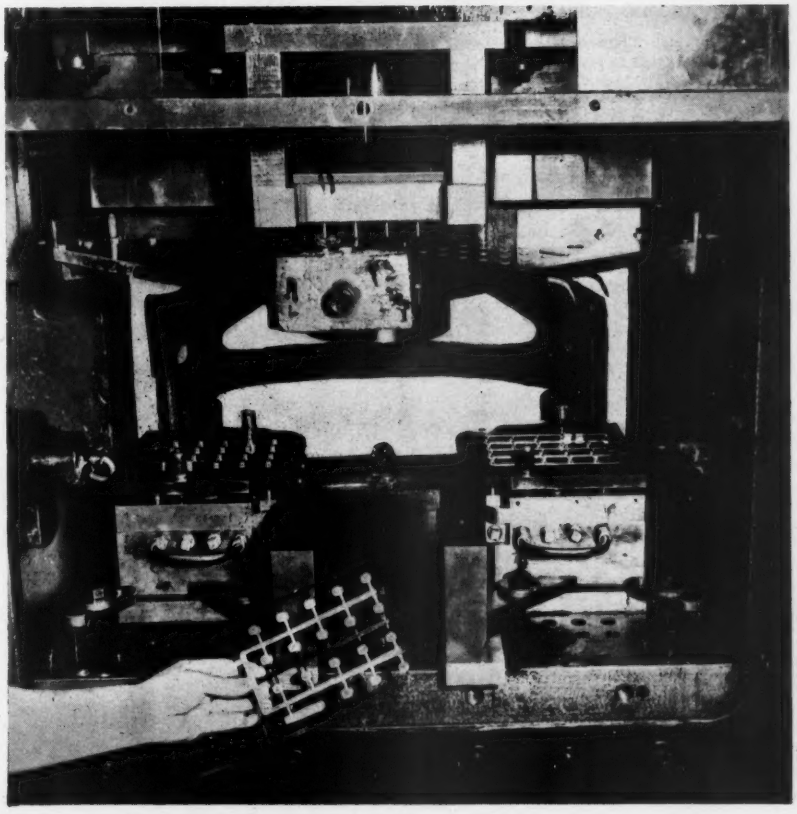


Fig. 3 (above).—Samples of first and second injection shots for numeral keytops, showing shells with impressions for the numerals, and finished keytops with second contrasting colour injected into the shells.

The moulds are built in three sections. The lower part, mounted to the stationary press bed, contains the core pins. Both lower moulds are equipped with stripper plates to guarantee that the moulded parts remain in the carrier plates during indexing.

Fig. 4 (right).—H.P.M. all-hydraulic injection machine for automatic moulding of calculator keytops, as installed in the works of Friden Calculating Machine Co., at San Leandro, California. The Hydraulic Press Manufacturing Co., Ohio, U.S.A., makers of the H.P.M. machine, are represented in Great Britain by A. C. Wickman Ltd., Coventry.

Fig. 5 (below).—Close-up view of four-station mould (front indexing cam track removed). The mould at the left is first colour; cooling station is at rear; second colour, right; ejecting station, front. Note the carrier plates mounted in the indexing spider; these plates are shown in their 45° position.



Four carrier plates—one for each colour mould and one each for the cooling and ejecting stations—are mounted in an indexing spider. These carrier plates contain the side-wall cavities of the keytops. The mould sections mounted to the moving mould clamp platen contain the cavities for the face of the keytops.

The carrier plates are indexed by means of two indexing cam tracts, one mounted at the front of the press, the other at the rear of the press. Movement of the mould clamp platen from bottom position to top position indexes the carrier plates 45 degrees and the downward movement of the mould clamp platen indexes the carrier plates the remaining 45 degrees, so that the plates are correctly positioned, over the four stations.

Production savings experienced by Friden with their new H.P.M. automatic two-colour injection machine will completely pay for the injection machine and moulds in approximately one year. Actually this full amortization period would be much shorter, if the injection machine were operated on a 24-hour a day basis, but Friden can supply its keytop requirements by operating only eight hours per day. Friden previously used one-colour keys, filling the characters with ink. This necessitated an ink-wiping operation. Now the keytops are produced automatically with only one operator, who removes the moulded keytops from the machine. It is not necessary for the operator to open and close a safety gate, as the parts are ejected automatically. In addition to cutting production costs, the new two-colour keytops are far superior in quality to those previously produced, as the characters are permanent and do not wear off with use.

The L.M.P. Meshed Multi-screw Extruder

PRODUCTION rights of the extruding machine built under patents of L.M.P., of Italy, have been secured for this country by R. H. Windsor Ltd., of London. This machine is surprisingly unconventional both for its widely embracing performance and for its divergence from existing engineering construction. In the one unit are simultaneously performed the normally segregated operations of compounding the raw materials, colouring, pelletizing and extrusion; therefrom may be produced a wide variety of shapes from single thermoplastics in sizes ranging from monofilaments to 10-in. diameter tubes or varieties of these, including the conjunctive extrusion of different thermoplastics.

The most arresting point of the machine, the one that governs its performance, is the fact that two intermeshing screws are employed instead of a single screw. It is because of this principle that two outstanding advantages are claimed.

(i) Any plastic material fed, by gravity, into the machine must, due to the design of the interlocking screws (both of which rotate in the same direction), advance at a uniform rate along the barrel of the machine to be displaced from the die end at a known and given time.

(ii) Perfect and thorough mixing of the materials is obtained due to the operation of the machine in obtaining this positive displacement—each particle being compelled by the direction and positioning of the screws, to change constantly and evenly its position from the inside to the outside of the plastic stream in the barrel, and vice versa.

To effect these primary advantages other smaller, but no less important, production snags have been overcome.

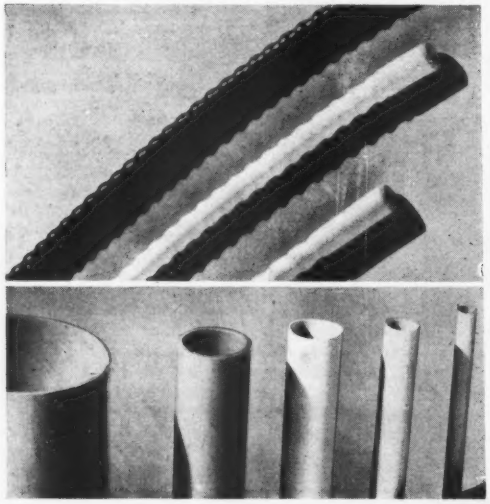
The temperature within the barrel of a single screw machine requires careful and regular conditioning, due mainly to the tendency of material in these machines to rotate with the screw, thus setting up undesirable friction and causing heat which is absorbed by the plastic stream, quickly worsening the conditions.

Material in single-screw machines is also inclined to take up a false position, either too close to the screw or too near the well of the barrel. It follows that the material is not being adequately mixed and that as those particles which are close to the wall of the barrel are nearer the source of heat than those by the screw, heating is also imperfect.

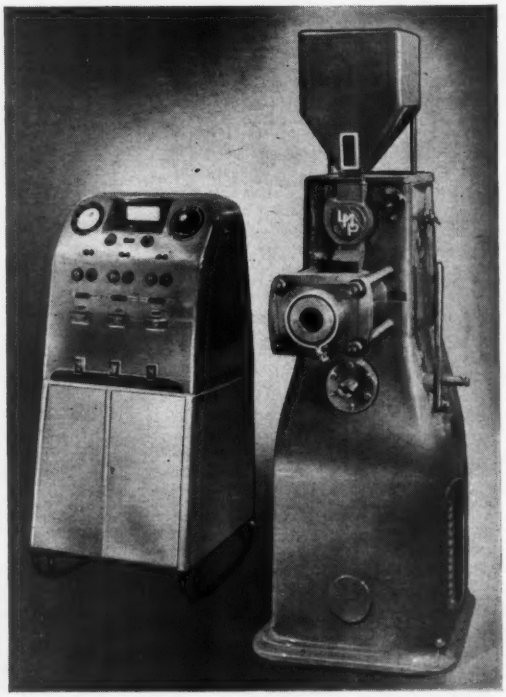
The action and setting of the double-screw machine obviate these tendencies, as the material cannot, by reason of the double worms rotating in the same direction, turn with them, and consideration of any temperature factor due to friction is accordingly eliminated.

It is equipped for either straight or cross head work. When two or more machines are operated in tandem, with fixed and moving dies, many different shapes of either continuous or variable sections can be produced in single or multiple colours. Extrusion pressure is high even with small sections.

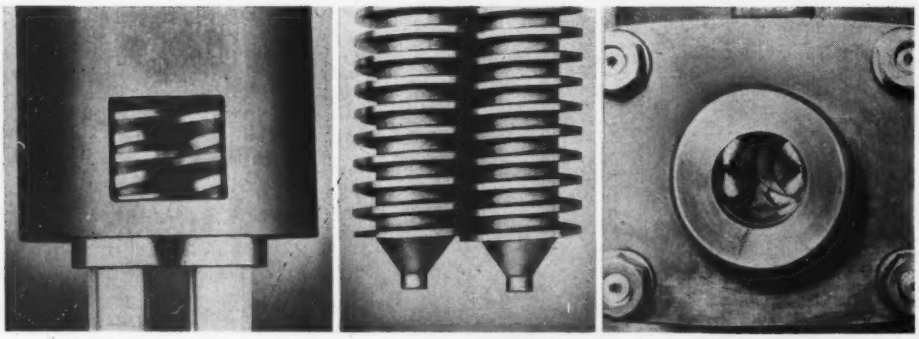
The machine, which is automatically lubricated and has an oil-cooling device, is run by a variable three-phase 5 h.p. motor, a horse-power not normally wholly absorbed. It has separate electrical heating units with thermostatic controls provided for the extrusion chamber, the die attachment



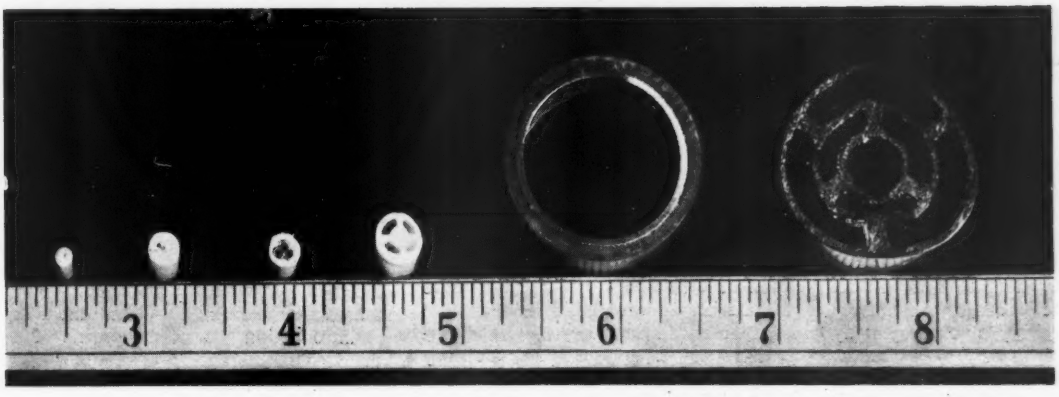
(Left) The L.M.P. machine produces flexible p.v.c. gas tubing with varying cross-section; also round sections, hard or soft, in a range of internal and external diameters.



(Above) Front view of L.M.P. meshed multi-screw extruder and control panel. The power take-off for pelletizing is placed immediately underneath the extrusion chamber.



(Left) The feed end of the extruder screws as seen through the opening to which the hopper attaches. (Centre) Delivery end of extruder screws, showing close meshing threads; both screws rotate in the same direction. (Right) End view of extrusion chamber, with adapter plate in position.



(Left) Typical extrusions with complex internal divisions; extruded wire casings are also made.

nut and the dies themselves. The low operating cost of the machine can be gauged by the fact that the power requirements of the heaters are 2 kilowatts for the chamber, and 0.8 kilowatt for the die attachment.

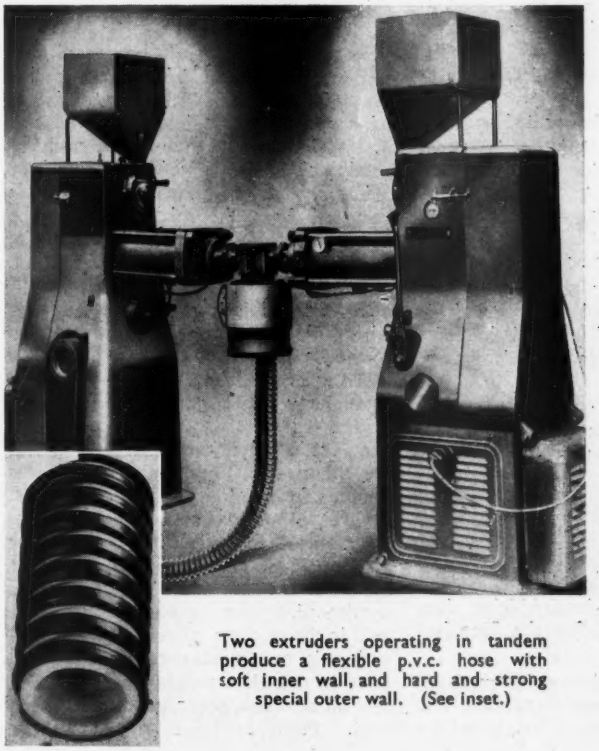
The fundamental principle of the two-worm extruder can be summed up as follows: Two screws, with threads meshing with each other, are each divided into three sections with different diameters and threads. The pitches of the mating flight sections on each screw are the same, thereby enabling the screws to turn in the same direction. On the 90 mm. (3.54 ins.) extruder, the outside diameters of the three flight sections diminish from feed to die end. Since the worms are closely meshed, the shaft diameter increases by the same amount as the flights decrease, to maintain a constant relationship between them; and, as the worm becomes smaller in diameter, their shape changes, the flights become progressively finer in steps, the coarser one being at the feed end, where the worms have the largest diameters.

The feed section of each worm has four turns of thread, the next has five, and the final, or extrusion, end has 14. The first two screw sections compress the material, fed in powder or granular form from the hopper, while the third section, with its many turns of threads, thoroughly mixes the material, raises the temperature to melting point, and builds up the required extrusion pressure. Shaft shoulders resist any back pressure from the material.

The inside walls of the extrusion chamber are shaped like a figure 8. They are reduced in dimension in two steps in order to follow the reduction in diameter of the three worm sections.

The actual screw section diameters on the 90 mm. (3.54 ins.) machine are 90 mm. at the feed end, 85 mm. (3.35 ins.) in the centre section, and 80 mm. (3.15 ins.) at the extrusion end. The corresponding shaft diameters are 40 mm. (1.58 ins.), 45 mm. (1.77 ins.), and 50 mm. (1.97 ins.).

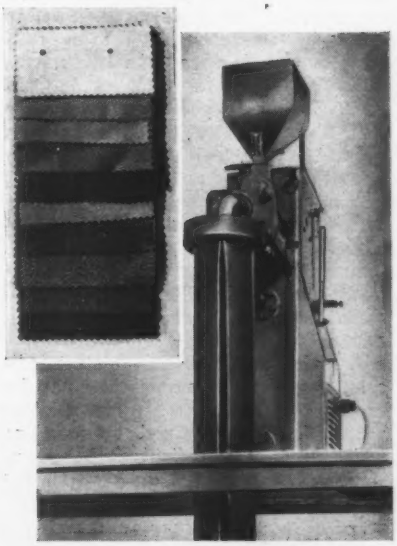
This new extruder is capable of producing round sections ranging from monofilaments .001 in. in diameter, to 10-in. tubes; film as thin as .001-in. strips up to approximately ¼-in. wide and in thicknesses of .020 in. or more.



Two extruders operating in tandem produce a flexible p.v.c. hose with soft inner wall, and hard and strong special outer wall. (See inset.)

The flexibility of size production is reflected in the ability to produce sheet material by the automatic slitting of 10-in. diameter extruded tube, thus resulting in 30-in. sheet, which can, if desired, be passed directly to embossing machines. Again, it is understood that one of these machines has already been ordered to produce 2-in. tubes of hard p.v.c., destined to serve for the novel purpose of irrigation piping in Australia, the hard p.v.c. being extremely resistant to corrosion by soil and to erosion.

Furthermore, work can be done with materials having different physical properties. For example, in one job two extruders are used for producing a special



Extruding and slotting one-colour p.v.c. tubing in a special die for the production of sheeting. The slit tubing is delivered to take-up rolls and an embosser.

gasolene hose (at 90 lb. to 95 lb. per hour). Soft polyvinyl chloride compound is handled by one, rigid polyvinyl chloride by the other machine. The materials extruded by the two machines are fed to a special cross head where two concentric tubes are extruded as a single and permanently fused unit with a soft inner wall and a rigid outer casing. A rotating mechanism within the cross head forms a spiral within the rigid material, while it is still in a plastic state. Close tolerances are held on all this work. The floor space occupied by this 90 mm. (3.54 ins.) machine is only 65 ins. by 28 ins.

The wide variety of shapes produced indicates particularly the unique extrusion die design. The range of dies employed runs from the standard stationary type to ingenious power driven attachments which make homogeneous non-uniform sections of one or more materials in many different forms.

Finally, the machine can be employed when desired as a compounding and pelleting machine for polystyrene, cellulose acetate, polythene, etc., thus making the factory more self-contained than ever.

R. H. Windsor Ltd. have secured the exclusive manufacturing rights for the British Empire and North and South America with the exception of Brazil.

Cross-linking of Cellulose Acetate

By R. W. MONCRIEFF, B.Sc., F.R.I.C., F.T.I.

SOME of the defects to which cellulose acetate is prone have already been summarized by Maxwell,[1] who says:—"Cellulose acetate, as well as other cellulose esters, is widely used in the form of fibres and fabrics, moulded articles, etc. However, cellulose products are relatively low melting and readily attacked by many commonly used organic solvents. Hence, wearing apparel made from cellulose acetate fibres must be ironed with extreme care and must not be allowed to come in contact with the ordinary solvents found around the home, e.g., finger-nail polish, alcohol, etc." Continuing, Maxwell points out that when such fibres are modified by the process of cross-linking, they are markedly improved in their resistance to solvents and in their safe ironing temperature.

Cellulose acetate is also widely used in moulded articles, but this application is limited by the solubility of the product in many solvents. By the same process of cross-linking, these moulded articles can be rendered insoluble in most solvents.

A review of the patent literature indicates that the advantages that may be expected to be derived, when cellulose acetate is caused to undergo reactions which result in cross-linking of the long substituted cellulose molecules, are in the main as follows:—

(1) A reduction which is usually advantageous in solubility.

(2) A higher melting point and a higher safe ironing temperature; a very considerable advantage, in as much as the great care that has had to be taken in ironing cellulose acetate has always been one of its cardinal defects.

(3) An enhanced resistance to creasing.

It will therefore be clear that cross-linking, if it can be satisfactorily carried out, brings advantages of considerable value from the commercial standpoint; consequently, it has attracted some considerable attention.

In carrying out chemical reactions on cellulose or cellulose derivatives, care must be taken that the long cellulosic chains are not broken down and the product degraded to any considerable extent. However, as it is impossible to avoid some breakdown in any chemical treatment of cellulose, the aim must be to keep this to a minimum. It would serve no good purpose to cross-link cellulose acetate and so reduce its solubility and increase its melting point, if at the same time degradation of the main chains was brought about with resulting embrittlement and loss of tenacity.

Some of the methods that have been described suggest treatment of the cellulose acetate in fibre form, i.e., as fibre, yarn or fabric, and in such cases there are often practical problems to be solved, to secure uniformity in the application of a treatment to large quantities of material, and to avoid damage that may be caused to the material by the production of by-products (particularly acids) of the reactions involved. This method of treating fibres preferably in hank or fabric form is often more suitable than a solution method, because it enables cellulose acetate, made and spun normally on large production plants, to be used as the starting material. Possibly, the spinning of cross-linked cellulose acetate may some day be undertaken, but it will be beset with considerable difficulties, inasmuch as (a) the cross-linking reactions reduce solubility so that it would be difficult to find a good non-degrading spinning solvent for cross-linked cellulose acetate, and (b) satisfactory methods of melt-spinning cellulose derivatives have not so far been discovered, the temperatures usually necessary being such as cause decomposition of the cellulose.

Other methods of cross-linking that have been described do suggest that the cellulose acetate shall be dissolved, i.e., that the cross-linking shall take place whilst it is in solution, sometimes precipitating as the cross-linking proceeds owing to the decrease in solubility. But in the main, solution methods are less likely to be of industrial value than those in which yarns or fabric can be treated as such.

It will later be noted that at least two methods (those involving the use of urea and melamine resins) have already been described in which it is proposed to spin yarn from an acetone solution of the cellulose acetate and the cross-linking agent, and then, after spinning, to heat to insolubilize the cellulose acetate. This intermediate type of method may be thought to have considerable advantages, notably as follows:—

(1) No alterations to the preparatory processes are involved until just before spinning, when the resin can be added.

(2) As the resin is added to a solution of the cellulose acetate, there is every opportunity for intimate mixing, and little likelihood of unequal distribution of the resin throughout the cellulose acetate.

(3) The curing or insolubilizing does not take place until after the fibre has been formed.

Some of the most interesting methods which are employed for cross-linking will now be described.

Use of Dicarboxylic Acids

The introduction of cross-linkages into cellulose acetate can be accomplished by treatment of fibre or yarn in an organic solution of a dibasic or polybasic acid as described in U.S.P. 2,372,386.[2] The method outlined in this patent includes the introduction also of the radicle of a higher monocarboxylic aliphatic acid, preferably of lauric acid or a higher homologue of it. This results in the production of a material that is substantially waterproof. At first sight it seems surprising that the introduction of so small a proportion of higher aliphatic monocarboxylic acid radicle (for this in general need be only of the order of 0.5—1.0 per cent.) should have such a pronounced effect on the properties of the cellulose ester. Fabrics and yarns treated in this way have a higher melting point and a higher safe ironing temperature than the cellulose acetate before treatment; in addition, the crease resistance is improved.

The introduction of the acid radicles is preferably effected by heating the cellulose acetate in a non-solvent medium containing a liquid organic non-solvent, such as xylene, and a low concentration of the mixed anhydrides of a lower fatty acid and a polycarboxylic acid and of a lower fatty acid and a higher aliphatic monocarboxylic acid. The mixed anhydrides may be prepared by heating a medium containing a non-solvent, such as xylene, for the articles to be treated, and a low concentration of a mixture of a lower fatty acid anhydride and a mixture of these acids, e.g., adipic and lauric acids and a lower fatty anhydride, such as acetic anhydride. Preferably any fatty acid formed or present in excess is removed from the mixture before the cellulose acetate is treated, since the presence of such acid during acidylation, except in a very small amount, tends to affect the cellulose acetate deleteriously. The following example illustrates the method employed.

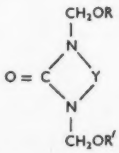
An esterification medium is prepared by boiling a mixture of 3 per cent. stearic acid, 0.4 per cent. adipic acid, and 1 per cent. acetic anhydride dissolved in xylene, for about one hour, and allowing the vapours formed to distil over. One part by weight of (acetone-soluble) cellulose acetate is then boiled in 100 parts by weight of this esterification medium, the vapours formed being withdrawn and condensed, so that accumulation of acetic acid in the medium is prevented. Esterification is continued until the materials have increased in weight by between 12 and 20 per cent., preferably about 15 per cent. Phthalic and tartaric acids are

suggested as alternatives to adipic acid.

There can be no doubt that some cross-linking occurs in this process, and it is to this structural change that the increases in melting point and in safe ironing temperature are due. The function of the stearic acid (or other higher acid, such as palmitic or lauric) is to give water-proofing, it being well known that this is usually obtained by the introduction of a long-chain fatty radicle. The reduction of the liability to crease is particularly noteworthy; no indication is given in the patent specification as to whether this improvement is caused by the cross-linking due to the introduction of the dibasic (or polybasic) acid, such as adipic radicles, or as to whether it is due to the introduction of a long fatty stearyl chain.

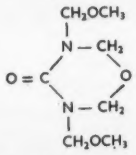
Use of Substituted Ureas

Maxwell,[1] in a patent assigned to E. I. Du Pont de Nemours and Co., has described the use of monocyclic N, N′-bis-(alkoxymethyl)-ureas of the general formula:—



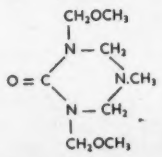
where R and R′ are alkyl groups, and Y is a divalent acyclic organic radicle of chain length 2 or 3, both terminal atoms of which are carbon, any other chain member present being carbon, oxygen, sulphur or tertiary nitrogen, and wherein all hydrogen atoms are attached only to carbon. Thioureas can also be used. Specific substances, whose use is described in the specification, are:—

I



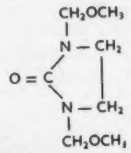
N, N′-bis (methoxymethyl) uron, or tetrahydro-3, 5-bis (methoxymethyl) -1, 3, 5-oxadiazin-4-one.

II



Tetrahydro-1, 3-bis (methoxymethyl) -5-methyl-2 (1)-5-triazone.

III



N, N′-bis (methoxymethyl) ethylene urea.

The first of these three products is that which appears to be preferred, and it can be made from formaldehyde and urea by the method of Kadowaki. A mixture of 220 parts 37 per cent. formaldehyde, 36 parts urea, and 3.6 parts barium hydroxide is heated at 90 degrees C. for 20 minutes. The solution is concentrated and the resulting viscous residue dissolved in 500 parts of methanol containing 3.8 parts of concentrated hydrochloric acid. After the mixture has stood for an hour the acid is neutralized and the methanol removed by distillation. The residue is dissolved in chloroform and the insoluble material filtered off. After removing the chloroform by distillation the product is distilled; it is water white and boils at 111-113 degrees C. at 2 mm.

An example of the treatment of cellulose acetate with this substance is as follows: A mixture of 15 parts of cellulose acetate (54.5 per cent. combined acetic acid), 85 parts of acetone and 0.525 parts of N, N′-bis (methoxymethyl uron) (I) is agitated until solution results; then the solution is poured on to a glass plate and levelled. The film so formed is aged for half a day and the last traces of solvent removed by heating at 65 degrees C. for three days; this mild treatment does not render the cellulose acetate insoluble, but if it is then heated for 90 minutes at 160 degrees C. it does become insoluble. It will be seen that in this example 3½ per cent. of the substituted uron is used on the weight of the cellulose acetate; in other examples 10 per cent. and 15 per cent. of the substituted uron are used.

The changes in properties caused by such processing are thought to be caused by a reaction between the bis (alkoxymethyl) uron and the free hydroxyl groups of the cellulose acetate, similar to the acetal interchange reaction between an acetal and an alcohol, i.e., a reaction taking place with evolution of the alcohol corresponding to the alkoxy group of the bis (alkoxymethyl) uron.

It seems clear that the cellulose chains are linked together by the substituted urea. The process bears some marks of similarity to that used for making crease-resistant cotton and linen.

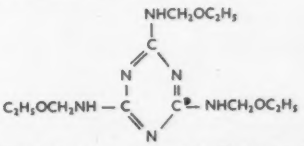
Use of Ethoxymethyl Melamine

This process has been described by Coolidge and Reese.[3] The application of the process results in an increase in the melting point of the cellulose acetate and in its insolubility in organic solvents; at the same time the material after treatment is still flexible and not brittle. The process consists essentially of dissolving cellulose acetate (in a state of acetylation lower than that corresponding to the triacetate) together with crystalline and substantially pure monomeric N, N′, N″-tris (ethoxymethyl) melamine in acetone, extruding the resulting solution to form a mass of the desired shape (usually filaments), removing the solvent therefrom, and subjecting the resulting mass, usually filaments, to elevated temperatures for a sufficient period of time to insolubilize the so-produced cellulose derivative.

In brief, cellulose acetate is mixed with an unpolymerized substituted melamine (both in acetone solution) and are dried out together; then, on heating, the substituted melamine combines with the cellulose acetate, cross-linking it and making it insoluble and increasing its point of fusion.

The quantity of substituted melamine used may be within the limits of 1 to 33 per cent. on the weight of the cellulose acetate. It is desirable for the substituted melamine to be entirely in the crystalline monomeric form and to be quite free from polymeric material, as small amounts of polymeric impurities defeat the purpose of the invention, since they interfere with the desired reaction to a surprising extent and are likely to result in a product which does not have the desired properties. Whilst many of the common solvents, such as ethyl acetate, dioxan, methyl "Cellosolve," etc., can be used, acetone is the most convenient and most widely used solvent.

N, N′, N″-tris (ethoxymethyl) melamine has the constitution shown below:—



The following examples illustrate how the process may be carried out:—

EXAMPLE 1.—Eighty-five parts of acetone are used to dissolve 15 parts (all by weight) of cellulose acetate (54.5 per cent. combined acetic acid) and 1.5 parts of N, N′, N″-tris (ethoxymethyl) melamine. The solution is cast into a film, which is levelled and allowed to dry overnight. Traces of solvent are removed by ageing for three days at 65 degrees C. The film is then heated at 160 degrees C. for 90 minutes to cure it.

In this process it is believed that cross-linkages are formed between the long cellulose polymeric molecules. The change in properties that results supports this view, for after treatment the film is insoluble in acetone and is infusible at temperatures of 250 degrees C. and higher. It does, however, show superficial fusion at 210 degrees C., compared with 195 degrees C. for the untreated cellulose acetate. This superficial fusion temperature is defined as being the temperature at which, when held under a 200-gram weight, the film first adheres to a brass block. Whereas the product prepared according to this example shows an increase of 15 degrees C. in the temperature of superficial fusion, another product made with half the quantity, i.e., 0.75 parts of the substituted melamine, shows

an increase over the untreated material of only 5 degrees C., starting to fuse superficially at 200 degrees C.

Apparently, the flexibility of the cellulose acetate film is very good if the quantity of substituted melamine used is 8.3 per cent. on the weight of cellulose acetate, but much less satisfactory if the quantity is either 4 per cent. or 10 per cent.; evidently the quantity used is very critical. The flexibility is tested by making a film 0.0025 in. thick and repeatedly folding through 180 degrees in alternate directions until breakage. If 8.3 per cent. of the substituted melamine is used, then folding can be carried out a total of eight times, whereas exactly the same film modified with 4 per cent. or with 10 per cent. of the substituted melamine breaks on the first fold.

EXAMPLE 2.—Seventy-five parts of acetone are used to dissolve 23.75 parts of cellulose acetate (54.5 per cent. combined acetic acid) and 1.925 parts (8.1 per cent. on the weight of the cellulose acetate) of N, N′, N″-tris (ethoxymethyl) melamine. After filtration the solution is extruded into a continuous filament yarn of 100 denier 40 filaments, and this is twisted to 4 t.p.i.; finally it is cured at 160 degrees C. for 90 minutes.

This yarn is insoluble in acetone, has a tenacity equal to that of the unmodified cellulose acetate, and is substantially infusible at any temperature. It is stated in the patent specification that whereas unmodified cellulose acetate yarn first shows superficial fusion at 155 degrees C., the treated yarn does not show it until a temperature of 175-185 degrees C. is reached. Both these temperatures are, however, very much lower than those mentioned for the film in the first example, and much lower than the temperature at which trouble from "sticking" during ironing is ordinarily first experienced.

It is suggested by Coolidge and Reese that fabrics made from cellulose acetate, modified in the manner described, will not require the use of special dry-cleaning fluids as is now the case for ordinary cellulose acetate materials. The following statement is also made: "Furthermore, infusibility of this product will prevent the damage caused to acetate fabrics when ironed at temperatures which are perfectly safe for other widely used textile materials, such as cotton and viscose rayon." This statement, however, should not be taken too literally, for the safe temperature of ironing is to a large extent determined by the temperature of superficial fusion, and the improvement in this respect which is reported in the patent specification is certainly not sufficient to enable the material to be ironed at temperatures that would be safe on cotton or viscose rayon.

(To be continued.)

REFERENCES

(1) *R. W. Maxwell (assigned to Du Pont) U.S.P. 2,373,135 (1945).* (2) *R. W. Moncrieff and H. Bates (assigned to Celanese Corporation of America) U.S.P. 2,372,386 (1945).* (3) *C. Coolidge and J. S. Reese (assigned to Du Pont) U.S.P. 2,375,838—2,375,840 (1945).*

LETTERS TO THE EDITOR

Correspondents are reminded that a stamped and addressed envelope should be enclosed in all cases where a personal answer is desired. It is understood that any letter received may be published at the discretion of the Editor.

Sugar as Plastics Raw Material

Sir,—Can you tell me whether sugar, one of the cheapest of raw materials, has yet been used in plastics manufacture?

Manchester. G.M.A.

[EDITOR'S NOTE: Many possibilities are known, but owing to the food situation there is little chance in the near future that anything will be accomplished practically. Directly, the most important result has been the examination of sucrose octa-acetate which is "akin" to cellulose acetate and should be much cheaper. Allyl sucrose is a material which can be polymerized and used for coating compositions. The most important results have been obtained from sugar and bagasse (omitting molasses, which is already a source of chemicals) by degradation. Thus sugar can be the source of possible nylon intermediates and new methacrylates; from sorbitol can be produced rubber-like compounds and di-methacrylate derivatives which are stated to give resins harder than polymethyl methacrylate. From bagasse, the cane residue, it is possible to produce a wide range of solvents via furfural and also adipic acid for nylon manufacture. An excellent article by W. L. Wiggins on this subject was published "Chemistry-Industry," August 6, 1949.]

Self-curing Dental Materials

Sir,—We have been searching through back issues of "Plastics" for information relating to the use of acrylic resins for fast, self-curing dental materials, i.e., a resin that may be cured directly in the mouth.

We realize the use of these resins for dental materials has been very limited up to the present time, and that very little material has been written about the subject. Have you any information that you can give us about this subject?

GENERAL REFINERIES, INC.
27, North Fourth Street,
Minneapolis 1, Minnesota, U.S.A.

[EDITOR'S NOTE: Perhaps our reader is thinking of "Palapont S.H.," which was made in Germany before and during the war, and is stated to be the subject matter of a British Intelligence Objectives Subcommittee Report in 1947. It consisted of methylmethacrylate admixed with tertiary amines, which acted as catalysts. On application of local heat, polymerization took place. In very general terms, the dental crevice was packed with the mixture and heat applied, the hardened resin thus making a filling.]

Plastic Tubing

Sir,—We should be glad if you could put us in touch with a manufacturer of plastic tubing. The size required is 17-32-in. inside diameter, with wall 3-32-in. thick.

JOSEPH WHITING AND SON.
11-12, Portland Square,
Bristol, 2.

Control of Sheet Thickness

Sir,—We are wondering if you can tell us whether it is possible to obtain an automatic device for continuously indicating the thickness of plastic sheeting as it comes away from the calender. We recollect reading of a device which employs a small amount of radioactive compound, the thickness of the material being in inverse proportion to the amount of radiation transmitted, but are of the opinion that this instrument is not made in this country. Any information you can give us on this subject will be very much appreciated.

T. J. SMITH AND NEPHEW, LTD.
Neptune Street,
Hull.
England.

[EDITOR'S NOTE: We do not know of the production of such devices in this country. More definite information should be sought from the Isotopic Information Officer at the Atomic Energy Research Establishment at Harwell, or from the British Scientific Instruments Research Association, 26, Russell Square, London, W.C.1.]

Plastic Tumblers

Sir,—We have received an inquiry from overseas friends of ours to trace the manufacturers of tumblers, etc., in plain plastic.

194, Bishopsgate, LEVETUS, LTD.
London, E.C.2.

Pegs

Sir,—Some of our customers have asked us for plastic pegs. Will you kindly give us names and addresses of makers of this particular line?

V. M. GLYNN, LTD.
Coventry House,
South Place, E.C.2.

New Productions in Plastics

Plastic Binding System

What appears to be an entirely novel method of plastic book binding for "lay-flat" catalogues, etc., has been developed by Olympic Industries, Ltd., of 11, Upper Grosvenor Street, London, W.1, differing considerably from the older types in which spiral or cut tubular forms are employed.

The "Swiveldisc" system is composed of two main components: (a) Slotted pages and covers, and (b) moulded discs, the former rotating or swivelling on the latter. The pages can be removed or replaced any number at a time by "springing."

The discs, which are made in sizes ranging from 8-mm. to 30-mm. diameter and in thicknesses as required, are injection moulded from cellulose acetate in ten different colours. "Swiveldisc" is world patented (B.P. 590431), the sole distributors being Ihlee and Sankey, Ltd., 38, Wilson Street, London, E.C.2.

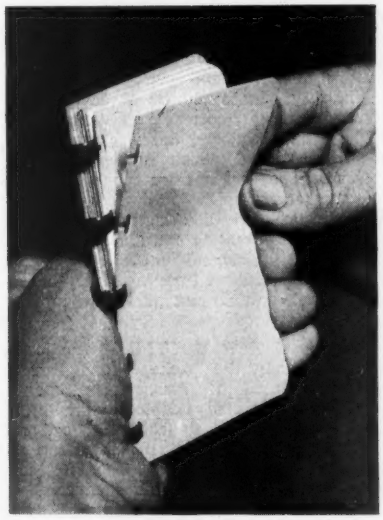
Cocktail Mats

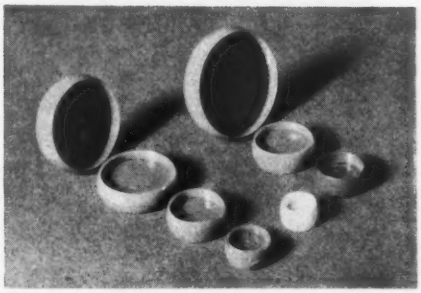
Lawleys, the famous earthenware, china and glass stores in Regent Street, are selling the interesting little "Paragon" set of cocktail "mats" which serve the very useful purpose of preventing alcoholic liquors staining polished table surfaces. They are of polystyrene, or cellulose acetate, and are packed in a transparent acetate container. One interesting point is the fact that this well-known concern has "accepted" plastics, while another is the "information label" included in the packing to the effect that the "mats" should not be used as ash-trays. This warning is a welcome feature which manufacturers have generally avoided in allied instances.

New Wyvern Pack

The new pack for the Wyvern pen and pencil, moulded in "Beetle" has the usual features of the carefully designed Illingworth product, the Illingworth snap-shut hinge being employed. Three-point suspension is provided to avoid any "rocking" tendency. The projecting front position of the base, on which is moulded a raised strip, engages with the corresponding projection portion of the lid, preventing lateral movement of the lid when closed. The inside of the case is lined; this padded interior unit, grooved to receive fountain pen and propelling pencil, is manufactured by Box Pada, Ltd., of Birmingham, and assembled into the case by the Wyvern Fountain Pen Co., Ltd. An appreciable slope ensures that the contents receive the maximum display value with the lid open.

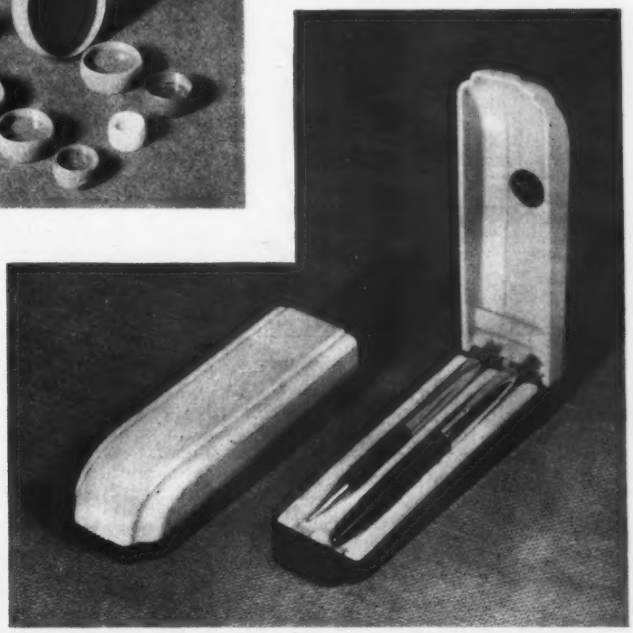
The container was designed by I. E. White, of Illingworths (Plastics), Ltd., by whom it was moulded from "Beetle" cream and black moulding powders.



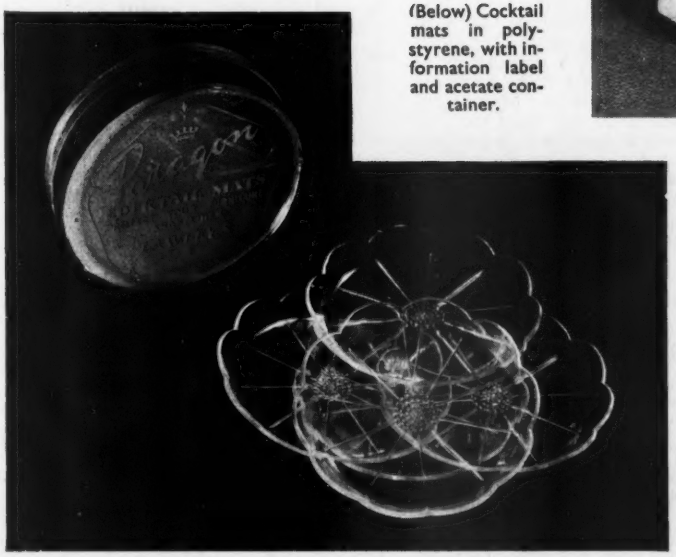


(Above and left) "Swiveldisc" plastic binding system.

(Below) New pack for "Wyvern" pen and pencil.



(Below) Cocktail mats in polystyrene, with information label and acetate container.

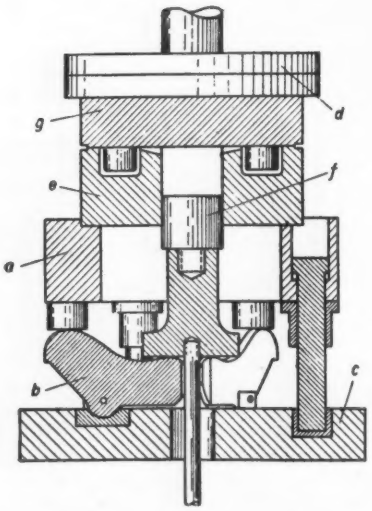


PRODUCTION NEWS

Raw Materials, New Plant, Works Organization, Control Apparatus, Research, Personal and Trade Notes

TRANSFER MOULDING ON DOWN-STROKE PRESSES.—K. Schoen, Luedenscheid, has developed a special attachment which can be used on an ordinary press with upper hydraulic cylinder, described in "Kunststoffe," 1949/July/162, and which is claimed to be no more expensive than a standard mould for a down-stroke press.

The ram of the press carries out two operations, i.e., injection or transfer of the mass, and closing of the mould. The lower part of the tool contains the mould cavities and the transfer cylinder. The piston (f) moves upwards in this cylinder. The mould (e) is closed by the upper ram (g). The



lower part rests on double-arm levers (b), number and size according to size of mould; these press the piston upwards. The levers (b) abut on the mould table (c). The lever ratio is such that the pressure of the upper ram is somewhat larger than that of the piston. This always ensures a well-closed mould, and that no mass penetrates between lower and upper parts of the mould.

Through the balancing action of the levers the upper part of the mould is always fully supported on the ring-shape part (a), and the closing pressure does not become larger than the pressure in the transfer piston, as usual with injection presses. In the new method, therefore, much smaller capacities are necessary, which do not need to be higher than with presses of the usual design.

For use in connection with a number of moulds, the new attachment is made in two parts. The basic part is formed by a ring (a), lever (b), baseplate (c), and press ram (d). The ring (a) carries the mould (e), with the transfer piston (f). The lower part of the mould (e) is closed by the upper part (g), which is directly contacted by the press ram (d). In the accompanying illustration the ejectors for the moulded component are omitted. Whereas each of the component parts (e) and (g), as also the piston (f), have to be specially made, the other components remain the same.

LAYER THICKNESS METER which has been included for many years in the range of industrial measuring instruments made by The General Electric Co., Ltd., has recently been redesigned and is now more convenient for measuring the thickness of non-magnetic coatings such as paints, sprayed metal, vitreous enamel, etc., provided that they are on magnetic bases. It is not suitable for measuring coatings of magnetic materials, such as nickel, on any base. The case of the new model has been changed and the whole instrument is now smaller and lighter. The exploring head is much smaller and fits inside the lid of the all-metal case when not in use. The range has been extended to 0.03 in., and the scale of the indicator has been made more open and easier to read. The lowest scale marking is 0.0005 in., but coatings down to 0.0001 in. can be easily gauged by interpolation. Any material with a permeability of unity may form the layer to be measured and any material with a permeability between 600 and 6,000 may form the base material. Overall accuracy is ± 10 per cent.

WOOD FLOUR.—We understand that the British Woodmilling Association has suspended activities and that the wood flour industry is now organized under the auspices of the National Sawmilling Association by means of a "Wood Flour Committee," which comprises all the recognized manufacturers of wood flour. At the inaugural meeting, held on October 13, grave concern was expressed at the threat to British manufacturers by the increasing import of wood flour and the ease by which import licences were apparently obtained; representations to and interviews with the Board of Trade have already taken place, and members of the Association have been advised of the results. The Secretary to the Committee is Mr. Robert Fothergill, National Sawmilling Association, 14, New Bridge Street, E.C.4.

TELCOTHENE.—A booklet just issued by The Telegraph Construction and Maintenance Co., Ltd., 22, Old Broad Street, London, E.C.2, describes the properties and uses of "Telcothene" polythene materials. This range includes polythene plasticized with polyisobutylene, or alternatively, mixed with other ingredients to give special properties. Sheet, film and rod, tube and piping are available for the food and chemical industries for conveying liquids; mouldings find use in the electrical industry. Surface coatings for paper and fabrics, and powdered "Telcothene" for flame spraying are other interesting applications. The present booklet gives data on electrical, chemical and mechanical properties.

THERMOPLASTIC GLAND PACKINGS.—Promising export orders are now being obtained for an entirely new type of plastic gland packing for use in the oil refining, chemical and food industries. This new packing is being developed by Crane Packing, Ltd., of Slough, a subsidiary of Tube Investments, Ltd. Fabricated from a new thermoplastic material of remarkable physical strength, the packings are almost entirely inert to solvent and corrosive attack by oils, chemicals and gases in regular use in industry. In the course of development research, the only corrosive substance found to have an effect, and this was minor, was hydrofluoric acid, which is used for glass etching. The packings are suitable for use in temperatures up to 450 degrees F. They are resistant to deformation, which is valuable in preventing extruding into clearance used in general engineering; being slippery and resilient in texture, they act as a lubricant, and do not adhere to moving parts.

PACKING FOR BOTTLES.—The resin-bonded wood-waste package for chemical samples featured in "Plastics" last month (page 82) was specially adapted by the Pontefract Box Co., Ltd., to take the 6 oz. and 16 oz. bottles in which British Industrial Solvents, Ltd., normally supply their samples of "Bisol" organic chemicals.

SWEDISH PLASTICS FEDERATION.—The fourth annual autumn meeting of the Swedish Plastics Federation will be held at the Gillet Hotel, Stockholm, on November 24 and 25, 1949. Several British and American films on various aspects of the plastics industry will be shown and papers will be presented by Scandinavian, British, American and German experts. The papers to be presented in English are:—

"Polymerization Conditions and Polymer Properties," by J. J. P. Staudinger, of British Geon, Ltd.
"The Application of Rigid P.V.C.," by T. V. L. de Nie, of Shell Petroleum Co., Ltd.
"Hycar Phenolic Blends," by R. P. Blaine, of B. F. Goodrich Chemical Co.
"Polythene Applications," by M. Jones, of I.C.I., Plastics Division.
"Cellulose Thermoplastics," by W. O. Brecken, of Hercules Powder Co.
"Manufacture of Celluloid," by C. M. Glover, of BX Plastics, Ltd.

Among the subjects of the Swedish and German papers are "Toxicity of Tricresylphosphate," by O. Blomqvist of the Stockholm Superphosphate Factory; "Classification of Plastics for Uses and Processing Purposes," by Dr. Lepsius. "P.V.C. Coatings," by R. Hagen, of Kautex-Werk.

BRITISH MOULDED PLASTICS LTD.—Mr. L. J. Scully has joined the sales staff of this company as area manager. Mr. Scully was previously general manager for Airfix Ltd., and before that sales manager of the Moulding Powder Section of BX Plastics Ltd.

BRITISH INDUSTRIAL PLASTICS, LTD.—In an interim report to shareholders for the year ended Sept. 30, the directors point out that, although the financial year ending on Sept. 30, 1949, covered the normal period of 52 weeks, against 53 in 1948, the turnover of the B.I.P. group has exceeded the record established a year ago.

"The problem dominating the greater part of the financial year, referred to in the chairman's speech last March," continues this interim report, "was the influence upon selling prices of finished products of the combination of shortage of urea with the rapid increase in practically every other item of cost in their manufacture. The directors are therefore glad to report that ample supplies of urea made in this country became available last June, and about the same time the peak of the rise in other materials was passed and costs began to fall.

"Demand has been well maintained throughout the year and it is still necessary to ration customers for first-grade Beetle moulding powders, the basic price for which remains but 25 per cent. above that ruling before the war. Now that ample urea is available, prices for Beetle cements have been reduced, and for the ordinary grades made before the war are lower than they were then."

MICANITE AND INSULATORS CO., LTD.—The Long Service Association of this company held its annual dinner at Lysbeth Hall, Soho Square, on October 15. One hundred and fifty-seven members and guests attended, including Major S. M. Mohr, O.B.E., M.C., M.I.E.E., president, and Mrs. Mohr, who made presentations accompanied by certificates to eight members who have recently completed 25 years of service, and to three members who are retiring from the company's employment. The association now has a membership of 118 and includes eight with service of 40 years or more, 43 between 30 and 40 years, and 28 between 25 and 30 years' service.

BRITISH RESIN PRODUCTS, LTD., announce that Mr. E. B. Rees has been appointed sales manager for their resins used in the surface coating industry, as from October 1, 1949. Mr. Rees will have his headquarters at 21, St. James's Square, London, S.W.1 (Whitehall 8021), and looks forward to keeping in close personal touch with friends in the industry.

TENAPLAS, LTD., extruded plastics manufacturers, of Upper Basildon, Berks, have changed their telephone numbers to Upper Basildon 333, 334, 335 and 336.

PETROCHEMICALS, LTD.—In their circular to shareholders, the directors of Petrochemicals, Ltd., state that four out of the five Caterole furnaces at their works in Manchester, converting straight chain oil products to cyclic compounds, are now working.

A. C. WICKMAN, LTD., of Tile Hill, Coventry, announce that arrangements have been completed for the well-known range of Fastraverse single, double and triple-action hydraulic sheet-metal drawing presses, injection moulding machines and die-casting machines to the designs of The Hydraulic Press Manufacturing Co., Mount Gilead, Ohio, U.S.A., to be manufactured by John Shaw and Sons (Salford), Ltd., Salford, Lancs. A. C. Wickman, Ltd., will be sole selling agents in Great Britain and certain export markets.

COURTAULDS LTD. announce that the negotiations to establish the first units of a rayon industry in Australia are well advanced. It is intended to form a company with a nominal capital of £A10,000,000, which will build factories for the production of both viscose rayon yarn for tyres and other industrial purposes and acetate rayon yarn for textile purposes. It is planned to erect the tyre yarn factory on a site near Tomago, New South Wales. The same site is suitable for the acetate yarn factory, but it might be decided to establish this elsewhere. The project is sponsored by Courtaulds and leading Australian financial and industrial interests, including Australian Mutual Provident Society and the Colonial Sugar Refining Ltd.

MR. H. W. GRAESSER-THOMAS, who has been severely ill during the past year, left on October 27, under doctor's orders, on a voyage to South Africa to recuperate. He will be accompanied by Mrs. Graesser-Thomas and will return shortly before Christmas. We wish him a speedy recovery to his old cheery self.

MR. J. E. E. PRICE has resigned his position as Works Manager of P. B. Cow and Co., Ltd., Factory Square, Streatham Common, London, S.W.16. He has been associated with the company for 16 years.

NOTES FROM BRITISH PLASTICS FEDERATION

Membership

E.V.D. Plastics, Ltd., have been elected to membership of the Federation and of the Moulders' Group.

British Industries Fair—Combined Federation Stand

In view of the expenses involved in showing at the British Industries Fair, the Federation has arranged to have a Combined Federation Stand, in which some 16 members of the Federation are co-operating. The Stand will provide a "shop window" for members participating in this scheme. They will be able to have a representative on the Stand to meet their customers.

Horners' Awards

Revised regulations for the Horners' Awards are about to be published and will be circulated to all members of the Federation.

Glossary of Terms

The Glossary of Terms which was prepared by the Technical Committees of the Federation is about to be forwarded to the British Standards Institution for a British Standard Glossary of Terms for the plastics industry.

Plastics Material Manufacturers' Group—Specification for P.V.C. Sheet

A specification for P.V.C. Flexible Sheet (or film) has been prepared by the Sub-committee of the Sheet Section, and this has also been forwarded to the B.S.I. to form a British Standard Specification.

Brochure on P.V.C. Sheet

The P.V.C. Sheet Section is preparing a brochure on p.v.c. sheeting which will be issued under the ægis of the Federation, for the use of those who sell this material. It includes, amongst other matters, a short section giving hints on how the sheet should be used to keep it in good condition.

Sea Freights

Arrangements have now been completed with the Australian, New Zealand, and Indian Conference Lines for the classification of plastics materials for shipping purposes.

Moulders' Group

The Moulders' Group have been discussing publicity and are setting up a Sub-committee to consider publicity within the Group.

Forthcoming Meetings

Nov. 11.—"Electric Heating in the Moulding Industry." G. T. Collins (Streetly Manufacturing Co., Ltd.). Plastics Institute, N.W. Section. Engineers' Club, Albert Square, Manchester, 2. 6.45 p.m.

Nov. 16.—Visit to Newcastle Telephone Exchange (2nd party). Plastics Institute, N.E. Section.

Nov. 16.—"Tool Manufacture." Speaker: To be arranged. Plastics Institute, Yorkshire Section. St. Mark's House, 186, Woodhouse Lane, Leeds. 7 p.m.

Nov. 18.—Problem Night. Discussion between members on technical problems relating to the Plastics Industry. Plastics Institute, Midlands Section. James Watt Memorial Institute, Great Charles Street, Birmingham. 6.30 p.m.

Nov. 22.—"Electric Heating in the Moulding Industry." G. T. Collins (Streetly Manufacturing Co. Ltd.). Plastics Institute, N.E. Section. Neville Hall, Newcastle-on-Tyne. 6.30 p.m.

Nov. 24.—"Costs, Oncosts and Wages." H. C. Starr (T.C.M. Co., Ltd.). Plastics Institute, London Section. Waldorf Hotel, Aldwych, W.C.2. 6.30 p.m.

Nov. 30.—"New Method of Synthesizing Resins and Plasticizers." E. Sunderland. British Association of Chemists. Wellcome Research Institute, Euston Road, London, N.W.1. 7 p.m.

Dec. 1.—"Plastics in Packaging." Harry Barron, Institute of Packaging, Waldorf Hotel, Aldwych, London, W.C.2. 6 p.m.

Dec. 5.—Dinner. Market Hotel, Birmingham. Plastics Institute, Midlands Section.

Dec. 5.—"Fibreglass." A. M. Robertson. Joint meeting S.C.I. and Royal Institute of Chemistry and London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1. 6.30 p.m.

Dec. 8.—"Acrylic Plastics," with special reference to their use in building and lighting appliances." R. Dew. Plastics Institute, Scottish Section.

Dec. 9.—"Protein Plastics." J. H. Collins (Erinoid, Ltd.). Plastics Institute, N.W. Section. Engineers' Club, Albert Square, Manchester, 2.

Dec. 13.—"Polymerization by Friedel-Crafts Catalysts." A. G. Evans (University of Manchester). S.C.I. Plastics Group. Chemical Society, Burlington House, London, W.1. 6.30 p.m.

Dec. 14 and 15.—Film Meeting. Plastics Institute, London Section. Gaumont-British Theatre, Film House, Wardour Street, London, W.1.

Dec. 14.—"Presses." W. H. Thripoleton. Plastics Institute, Yorkshire Section. St. Mark's House, 186, Woodhouse Lane, Leeds. 7 p.m.

PATENT REVIEW.—Due to lack of space, our "Patent Review" is held over until next month.

Successful Designing for Plastics Moulding—IV

By W. M. HALLIDAY

IN the last instalments ("Plastics," Sept. and Oct., 1949) considerable attention was devoted to the description of the advantageous features—physical, mechanical and æsthetic—possessed by some of the most commonly used plastic materials. This description was presented primarily to afford some guidance to the non-plastics technician, and especially the general engineer-designer who is often called upon to design an article in such materials.

As a preliminary to the development of any sound and successful component design it is essential that the most appropriate material and method of moulding or fabricating such material be selected.

Still further to assist towards that same objective, it will doubtless be found of considerable assistance if a short account is now given of some of the chief reasons which incline designers to adopt plastics moulded parts in preference to those made of wood, metal or any of the other more conventional constructional materials.

Ease of Shape Formation

Most plastics materials may be very easily and economically converted into practically any shape because of the great variety of forming processes and methods available. Most materials are, in fact, moulded either by the compression, injection, transfer or extrusion methods.

With these latter methods of production practically any configuration of a component is possible, consistent, of course, with the reproduction of that shape in reverse form in the mould or forming tool. This indeed is a most important feature which should constantly be borne in mind by the designer. At a later stage in this series a considerable amount of attention will be given to this aspect of successful designing practice, and numerous practical examples will be given to illustrate the pitfalls which are to be avoided and the preferential design forms to be selected.

Shapes for moulded components especially may be of a very intricate character. The limitations in this direction being the ability of the skilled toolmaker to reproduce such a shape in the mould with accuracy and economy, or the ability of the moulder to operate the tool effectively, or both of these considerations.

By the introduction of cores (of one kind or another), holes, recesses, undercuts, complicated contour, and similar difficult shapes may be readily formed on a moulded component. Such coring provisions built into a plastics mould may be fixed or movable as circumstances demand. Cores of the movable kind can be arranged in a variety of ways so as to slide laterally through the mould block, to rotate therein, or to screw into threaded holes provided in the mould, and so forth. Such recesses, etc., may be formed on the exterior or interior of the part.

Furthermore, the designer has to remember that it is comparatively easy to fashion threaded portions on a moulded component with accuracy, and often without adding to the operating cycle time for the mould. Internally threaded holes, or externally threaded projections, can be produced with equal facility within specific size ranges. These, and some other important limiting factors, will be described and explained in a later section of the series.

In cases where a metallic screw, etc., has to be repeatedly inserted into the finished moulding, in order to overcome the liability to wear on the threads of the moulded plastic article, the designer may introduce what are known as metallic "inserts." These are extensively used in the case where a component has a number of small diameter threaded holes having to withstand such wear effects, or when the diameter of the hole is too small for safe moulding. A small metallic "brass" or aluminium bushing having a threaded hole is admitted to the mould, and is thus moulded in its correct position in the component. Very secure anchorage may be obtained for such insertions, because the natural contraction of the plastic material attendant upon cooling is utilized for binding the metallic insert in place.

Uniformity and Dimensional Stability

In many instances where the shape of a component is judiciously blended or adapted expressly to suit the requirements of the moulding process, costly subsequent difficult machining or assembly operations may be completely eliminated, or appreciably simplified in some manner. Alternatively, it often happens that such a blending of component shape and design forms, the better to suit mould construction or operation, will permit the component to be made as a single moulded piece, thereby removing the necessity to make it from several smaller separate units, which may be entailed if any other manufacturing method and materials had to be selected.

In these, and many other similar ways, considerable economies may be obtained by the far-seeing designer. Such economies may often prove of such a magnitude as to render plastics moulded articles the most economical kind of components to employ.

Another very important reason which often appeals to the engineer-designer when having to decide whether or not to use plastics mouldings, is the high degree of dimensional accuracy and shape uniformity achieved by the moulded processes. By the compression and injection-moulding processes especially very close control can be obtained over dimensional variations.

This is a particularly valuable feature, especially when large quantities of components are envisaged, each of which has to be produced to a high standard of size of shape duplication. It will also prove invaluable when precision-type moulded components are required, embracing a number of dimensions upon which close limits of error are fixed.

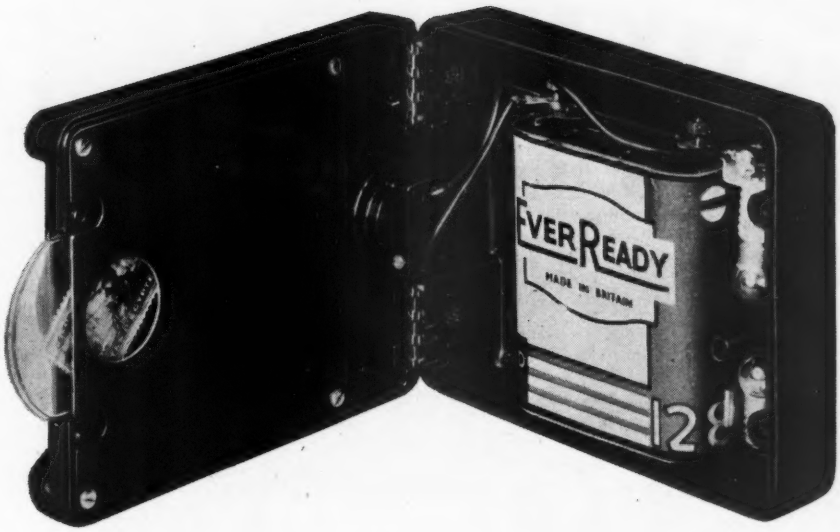
In the range of phenolic plastics materials, which are largely used for industrial and electrical purposes, immense quantities of components have to be produced within close dimensional limits and exactly to the same shape. Such exacting requirements are economically satisfied by the plastics moulding process.

Usually, moulded articles are produced from metallic (alloy steel) hardened dies, having a permanent cavity impression shape, which is thus capable of being produced to very fine dimensional accuracy, and also can be maintained within those precision limits over long periods of production use.

Mould-making practice and technique are constantly being improved by the development of new mould steels, or by the introduction of new methods of mould manufacture to enable difficult constructions, especially in respect of cavity formations, to be more easily obtained.

Knowledge of such mould manufacturing developments will often prove of inestimable value to the engineer-designer when embarking upon the evolution of a plastics-moulded component design, because mould design is very closely related to manufacturing as well as component design.

To some extent, control over dimensional and shape variations in a plastics moulding will be dependent upon the type of material employed. Some materials have a greater degree of inherent shrinkage than others, and so will contract a greater amount upon leaving the mould. Secondly, the quality and accuracy of the mould construction itself will also influence the uniformity and accuracy of the finished parts.



PHILATECTOR—a new use for moulded plastics

This is the ingenious "Philatector", an instrument for the accurate detection of watermarks, which has been re-designed for H. & A. Wallace (Philatelists) Ltd. by British Moulded Plastics Ltd. The two-piece case and filter holder are phenolic mouldings, and the slide, filters, switch and retaining plate are all made from plastic materials. Design, moulding and assembly by

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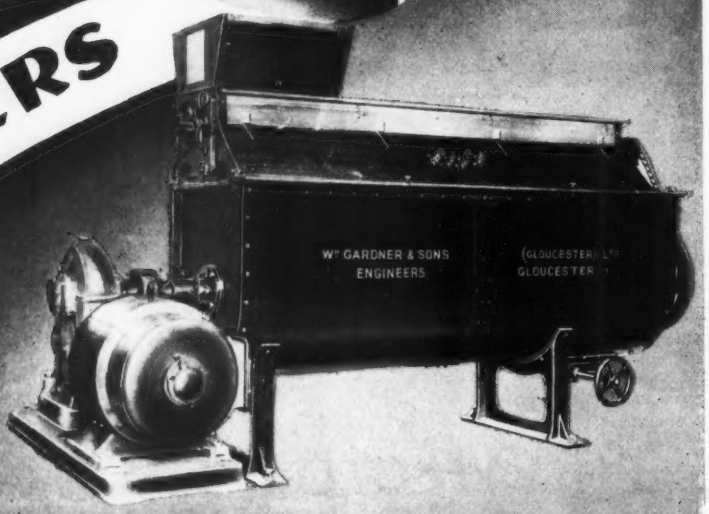

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Thirdly, the operating technique employed during the moulding operation may also introduce factors, which, in turn, will produce variations in the shape or size of components in a batch.

New plastics materials possessing greater stability and permitting more rigid control over shrinkage or warping attendant upon mouldings, are almost daily being evolved. Knowledge of such new processes and plastics materials will prove of tremendous interest and utility to the designer, who thereby will find many of his problems appreciably elucidated.

Economical Production.

In cases where the total quantity of moulded components is very large, moulding may be found a very inexpensive and economical matter. Care has to be exercised by the designer when assessing this point, however, since total batch quantity ordered or required is not always the sole deciding factor.

The number of mouldings required must be sufficient to warrant the necessary initial outlay on moulding tools, etc., and all the other mechanical accessories attendant upon efficient manufacture and inspection of the parts produced.

In nearly every instance the designer will have to reach a balance between quantity and tool costs. Often the shape of the component itself, rather than the quantity, will determine whether to employ mouldings or not. Thus, in the case, say, of a very intricately shaped article, of which only limited quantities are required, upon examination of all the factors and other costs associated with different methods of manufacture, it may be found that moulding is really the most economical proposition notwithstanding the relatively high mould charges involved when spread over the small quantity of parts.

Another important aspect of this same problem relates to the case where, by having a plastic-moulded component, several succeeding operations are eliminated or appreciably simplified. The total savings effected by the adoption of a plastics-moulded article may then be found to offset far greater the costs of the moulding tools.

Yet again, in the case of very large batch quantities of parts, the designer has to remember that it may be possible to employ multiple impression moulds, with identical cavity formations, or multiple impression combination moulds having sets of cavities, with each set of different shape. By means of moulds of this character, complete sets of mouldings comprising several unit parts may have been produced at each shot or cycle of the moulding machine. Whilst such elaborated moulding tools will cost much more than single impression tools, far greater production rates and outputs will be obtainable, and, therefore, there will be a considerable reduction in overall production costs.

Production and mould manufacturing costs of this and a related kind often forms one of the chief considerations confronting the designer. This is one of the chief reasons why it is essential that he be well familiar with the various moulding processes and their requirements, so that a component shape and design may be fashioned as closely as possible in conformity with them.

Equipped with such knowledge the designer will also be guarded more effectively against stipulating difficult shapes or dimensional tolerances, which if persisted in, through to the production stages, may involve a great slowing down of the moulding procedure and the rate of output. For the same reason, too, worth-while savings may be obtained in the actual mould costs if the simplest component shapes are selected consistent with efficient machining of the mould and satisfaction of service requirements.

Strength and Weight

Very many of the plastics materials are extremely light in weight, yet at the same time possess considerable tensile and compressive strength. This feature is often utilized to great advantage by the designer, because it enables him to have a component of relatively thin wall section but of due strength for his purpose. The process of moulding, either by the compression or injection method, also readily permit ribs, bosses, beadings, fillets and similar strengthening formations to be incorporated in the component, and at the same time easily included in the mould construction.

Thus, from this angle, the designer will know that he can often effect considerable economies in material without sacrificing any of the mechanical strength of the finished article.

Considerable care has, however, to be exercised when introducing such strengthening features to ensure that they are located in such a way as will enable the mould to be constructed in the simplest manner, and to allow the finished moulded article to be readily withdrawn from the mould.

For many applications these two factors of weight and strength alone conspire to make the use of plastics highly desirable, and indeed in some cases vitally necessary. Good examples of such applications are plastics components of various kinds to be used for the internal fittings of aircraft.

Heat and Electrical Insulation Qualities

Nearly every type of plastics material possesses excellent insulating qualities against heat and the passage of electrical current. Furthermore, not only can they be used purely as insulators in either application, but they can be also employed as structural members on account of their strength and stability. This, indeed, is often a most useful dual feature, which can be turned to great advantage by the designer when one bears in mind that many of the more conventional insulating materials, such as asbestos, mica, porcelain, etc., have very low mechanical strength, and thus usually can only be safely used for the single purpose of insulating.

Simplified Designs of Component

Another valuable feature which will often strongly appeal to and interest the engineer-designer when contemplating the use of plastics mouldings, is that the process of moulding will often enable very considerable simplification to be made to the shape, sizes, contours or relationship of the moulded part to other components in similar materials, or in metals, wood, etc.

Many plastics moulded components, particularly those for industrial applications, have to be specifically designed for use, or operation in conjunction with other components, or as members of an assembly comprising articles in wood and metals as well as plastics materials.

Where a component in metals has to be substituted for one in plastics, considerable economies may be derived if the shape, etc., can be modified in some manner the better to suit subsequent assembly or machining functioning. If such a metallic component has to be built-up from a number of small units to fashion the requisite shape, the simplifications afforded by using a plastics moulded article will often be important to the designer and user.

Surface Finish and Colour

From the list of physical and mechanical properties possessed by plastics materials described in the previous section, it will be appreciated that practically every plastic material is capable of being reproduced, either by moulding or fabricating from sheetings, with excellent surface finish. This, again, constitutes a very valuable feature for the designer, chiefly in those cases where the moulded component has to be distinguished by high-quality surface smoothness or with a pleasing appearance.

Many materials have valuable transparent or translucent properties. This renders their use especially advantageous in certain obvious applications as a superior substitute for glass. Indeed, innumerable optical applications are now being satisfactorily fulfilled by the transparent group of plastics materials.

The range of colour possibilities with plastics materials is almost unlimited, and certainly unexcelled. Not all colours are available in every material, of course, notably such a limitation is present in respect of the phenolics, which generally are in the darker shades.

The designer will appreciate also that very great possibilities are open to him

in regard to colour blending. Not only can plastics be obtained in a great variety of natural colours, but surface finishes to give colour combinations or contrasting effects can easily be applied after moulding has occurred.

In determining this aspect of component design, however, it is essential to bear in mind that a colour or shape which gives an attractive appearance in, say, a metallic component, will not necessarily produce a pleasing appearance in a plastic moulding. This will be particularly the case with the dark brown or black phenolic plastics materials used for industrial applications, because a plain, unrelieved or undecorated black piece will have poor inherent surface interest.

Attractive contrasting coloured effects may be obtained quite readily with many plastics materials. This may be achieved either by the external application of paints, enamels, lacquers or plating deposits after the component leaves the mould. On the other hand, the article may be actually moulded in sectional form, each in a different colour, and then assembled simply to complete the component.

Plastics materials can also be very tastefully combined with polished, electroplated or lacquered metallic surfaces, to obtain other desirable and attractive colour contrasts. This, indeed, is a field of development which has only just been opened up. Its full development certainly will afford great scope for the designer fully alive to the importance of the æsthetic values and who requires moulded articles of superior or unusual surface finish.

From the angle of the development of a whole set of new colour combinations for use with or to replace those components which, in the orthodox and uninspired colours or colour combinations, now given them, undoubtedly cause eye strain, fatigue, and repel interest, the plastic designer has tremendous opportunities.

Yet another very useful feature associated with most plastics which will often appeal to the designer of parts intended to fulfil a purely utilitarian function is that of the pleasant "feel" possessed by these materials. Such a feature will be most appropriately associated with components which have to be handled constantly, e.g., small hand-tools, handicraft appliances, domestic ware, etc. The satisfaction of the sense of touch is an angle often completely ignored by the engineer-designer, as is evidenced by the continued appearance of handles, knobs, gripping devices of various kinds which often are of such a shape, and material, as to be most repellent to pleasurable retention, and inconducive to minimum strain attendant upon constant handling.

Far too often articles of this kind, of which a file handle is a very good example, are made of such a shape that the hand cannot obtain a natural grip thereon. These result in strain on the fingers or the wrist of the user, thereby leading to earlier fatigue or a drop in efficiency of operation. The amount of strain and loss of nervous energy attributable to such a simple cause may not be computable, but anyone who has to use a wrongly shaped handle on a tool, or one made from an unsuitable material for a lengthy period, will understand the nature of such a loss.

This, again, is a field in which the plastics moulding designer can play an important role because of the availability of a number of materials having a pleasurable "feel" to the sense of touch.

This completes the brief general survey of some of the chief reasons leading to the use of plastics materials. Those given, however, by no means exhaust all the advantageous and interesting features possessed, but others will be indicated in later sections in reference to specific design applications to be considered.

In the next section consideration will be given to the various essential requirements of component design.

With practically any kind of plastics moulded article the following factors will have to be considered by the designer. First he will have to settle the question of function. This may appear an obvious point which, it will be supposed, will automatically settle itself since the prospective user must know what object has to be achieved, or operation performed, by the article. Next, decisions will have to be taken on the service conditions to be met by the component. Then will come the question of the selection of plastics materials to produce a component capable of meeting the service conditions, and a decision as to shape and size.

After this has been disposed of, the designer will need to call into question the mouldability of the article as designed to that stage; here modifications may have to be made to shape, size, or projected material. Consideration will also have to be given to the question of costs, both in relation to the moulding tools required, and the actual production of the mouldings themselves.

Finally, attention will have to be devoted to the question of appearance, surface quality, and the general æsthetic value of the finished components.

(To be continued.)

Indentation Hardness of "Gesalith"

OUR recent report on "Plastics at the Hanover Trade Fair" ("Plastics," July, 1949, p. 358) referred to a new laminated material, "Gesalith," which is produced by G. H. Sachsenröder, of Wuppertal, Germany. Micro-hardness tests which have now been carried out on a sample of this material appear to indicate that the machining properties are similar to those of mild steel.

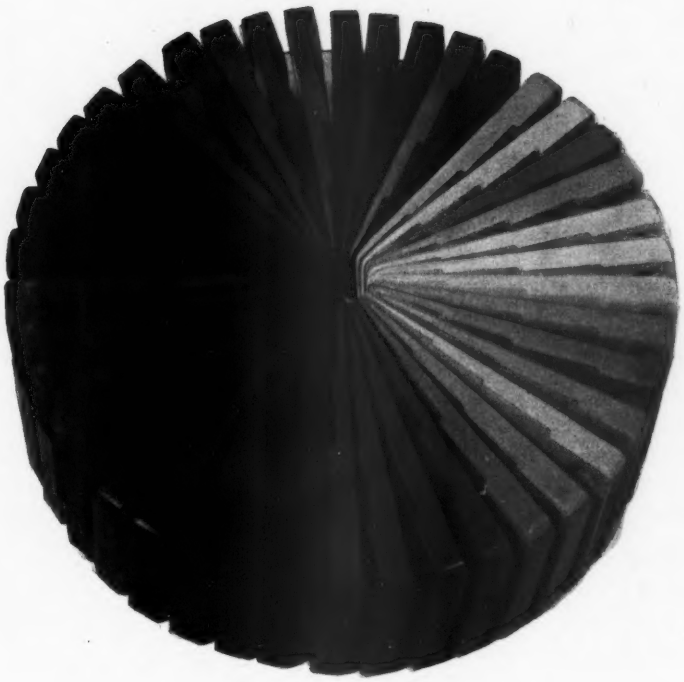
The tests were carried out on the new optical Macro-Micri hardness tester of Industrial Distributors (Sales), Ltd., using a diamond pyramid (Vickers) indenter and, alternatively, the double-cone indenter according to P. Grodzinski. Tests under a load of 1 kg. were made on all three faces of the cube. The time during which full load was applied was 1 min. Results are given in the accompanying Table.

The face parallel to the laminæ appears to be the hardest in the diamond pyramid test. The double-cone indentation has about the double length of the diagonal in the diamond pyramid test, and, therefore, this test allows to distinguish in a plane normal to the laminæ, between a direction parallel and a direction across to the laminæ, demonstrating interesting differences. The direction across the laminæ (in a plane normal to the laminæ) appears to be the hardest.

These micro-hardness tests confirm the statement of the manufacturer that this material has a "hardness" (not further specified) of 218 kg./sq. mm. (not 21.8 kg./sq. cm., as previously published). The hardness can be considered relatively high for a material of plastic basis, and supports the claims of the manufacturer.

Plane	Direction	l mm.	l (mean) mm.	d mm.	d (mean) mm.	D.P.H. kg/sq.mm.	$HBC = \frac{1}{0.361 \times l^2}$ kg./sq.mm.
Parallel laminæ	1	0.546 0.549	0.5475	0.314-0.288	0.303	202	169
	2	0.576 0.580	0.576	0.310-0.300			144
Normal laminæ	parallel laminæ	0.546 0.576	0.561	0.313-0.335	0.329	172	157
	across laminæ	0.540 0.538	0.539	0.326-0.342			177
Normal laminæ	parallel laminæ	0.576 0.576	0.576	0.313-0.320	0·324	177	145
	across laminæ	0.557 0.540	0.5485	0.320 0.344			168

l = length of double-cone indentation, indenter constant C = 0.361.
d = diagonal of diamond pyramid (Vickers) indentation.



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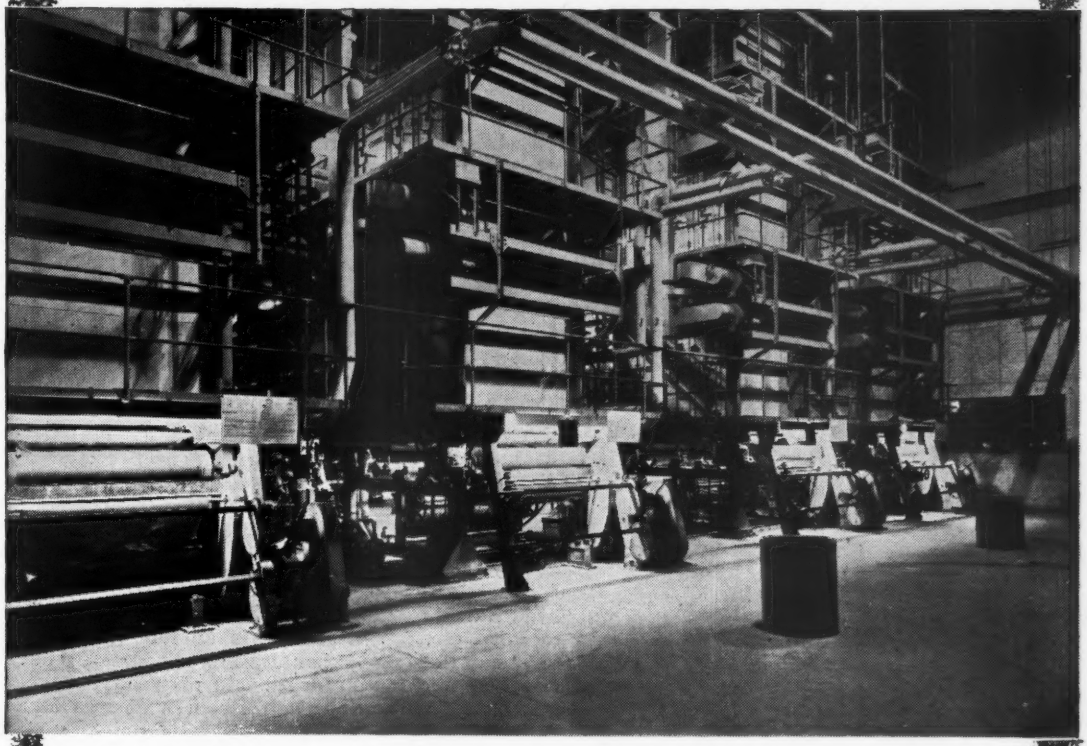

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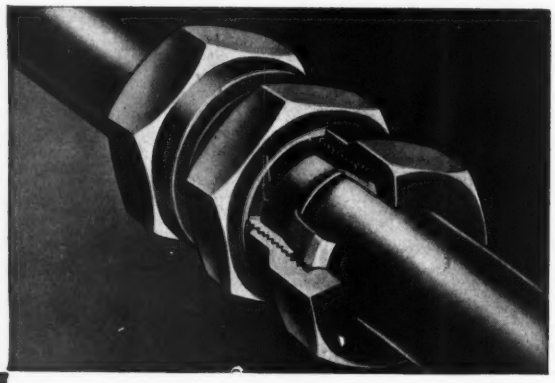

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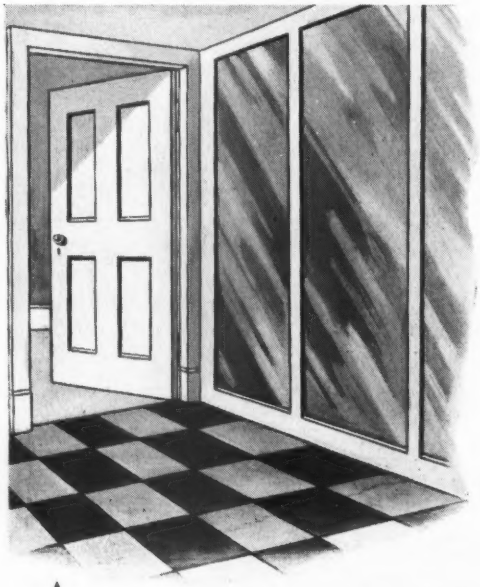

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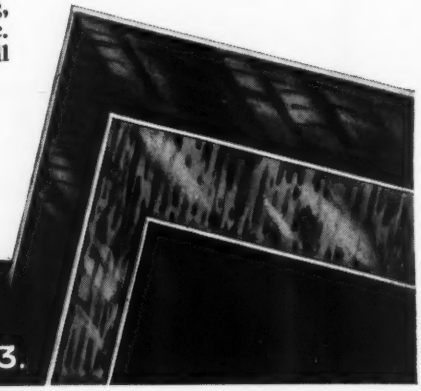

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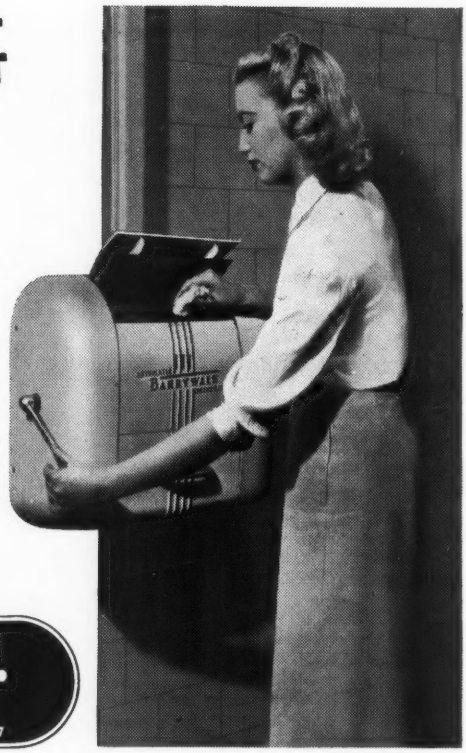

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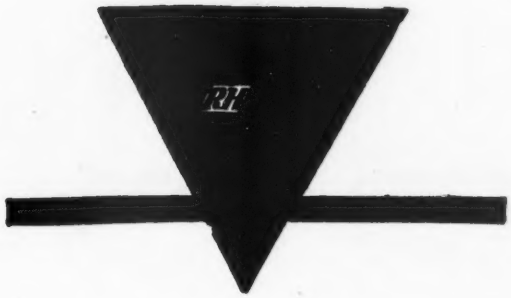

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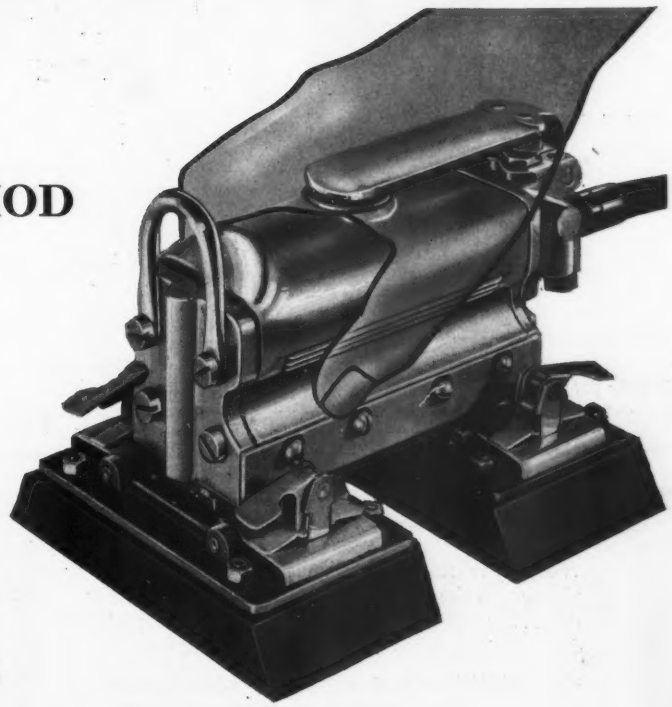

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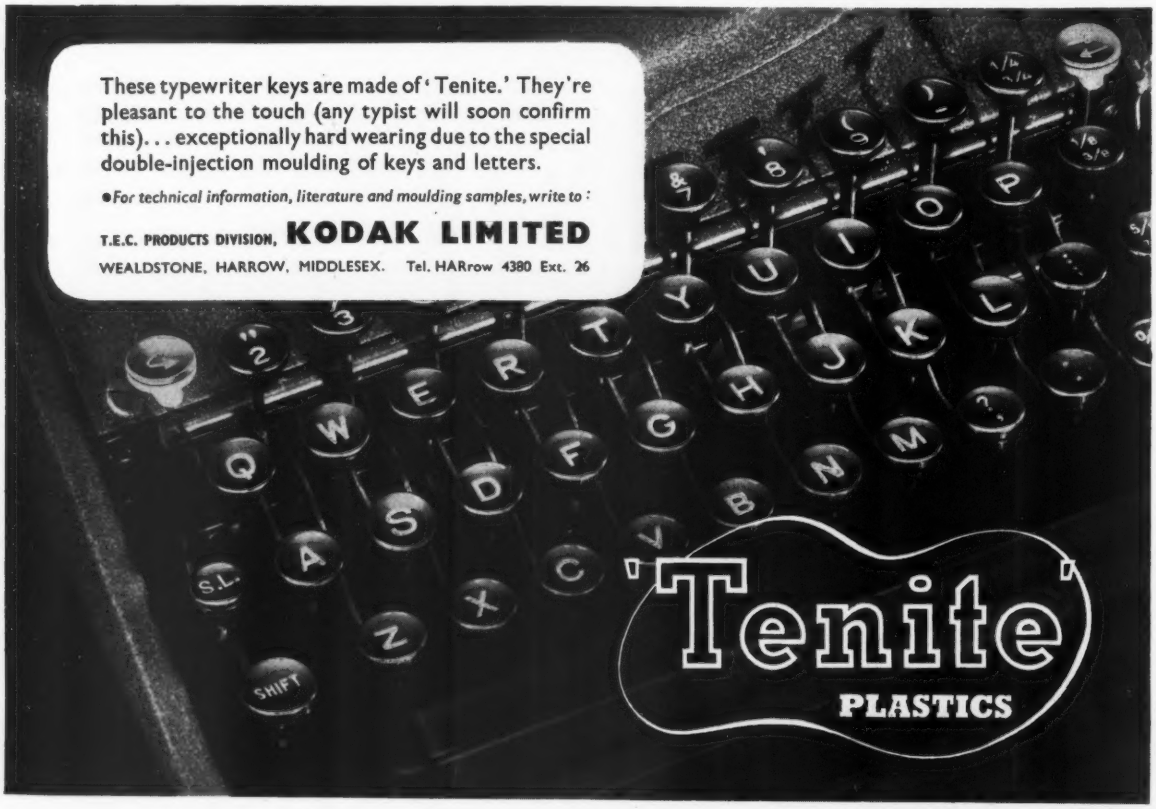
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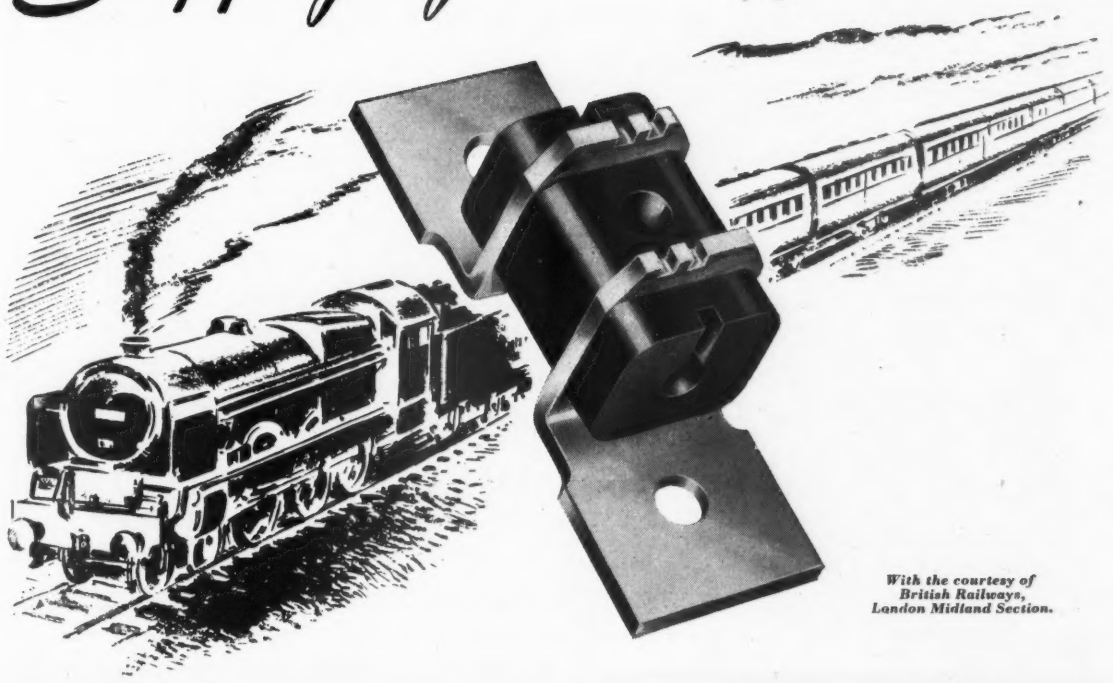

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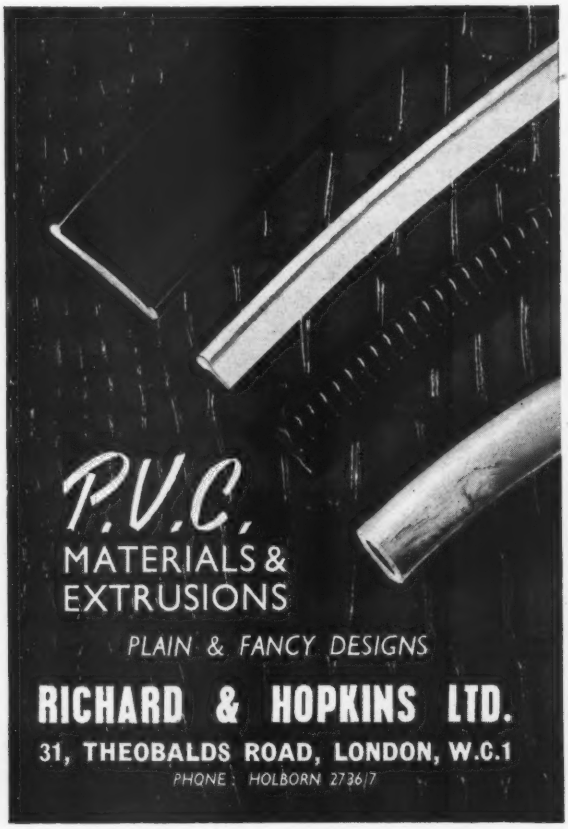

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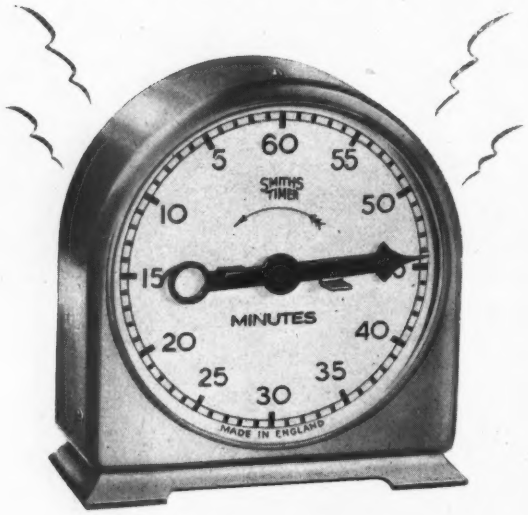

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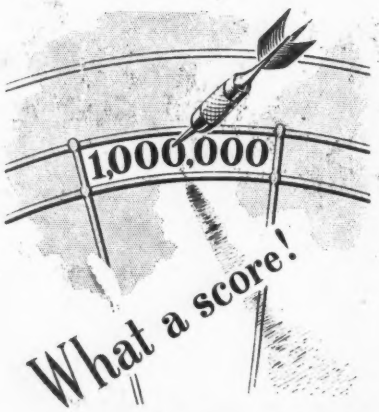

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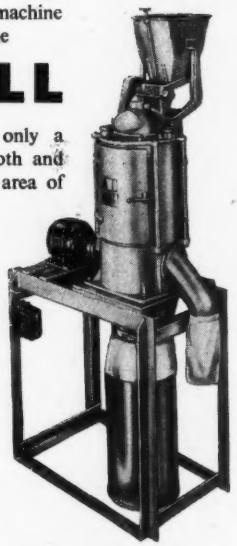

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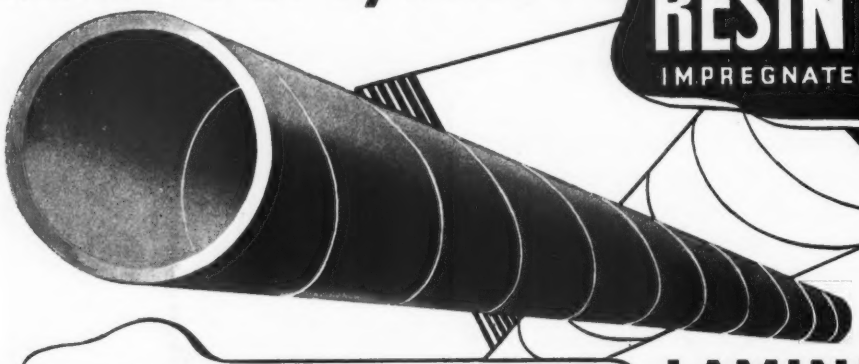

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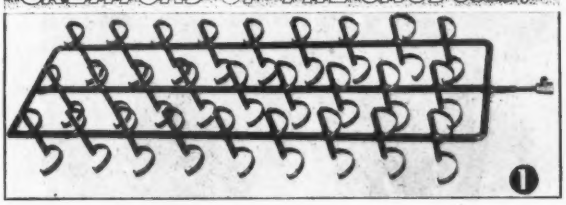

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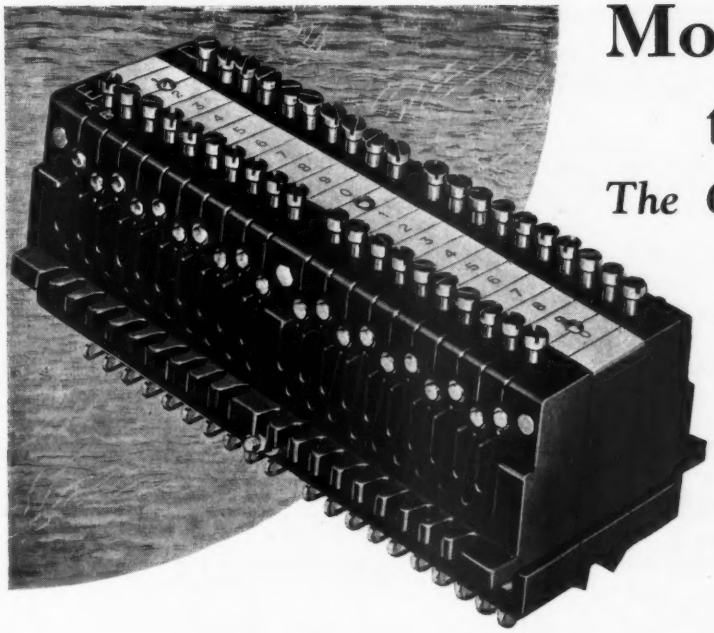

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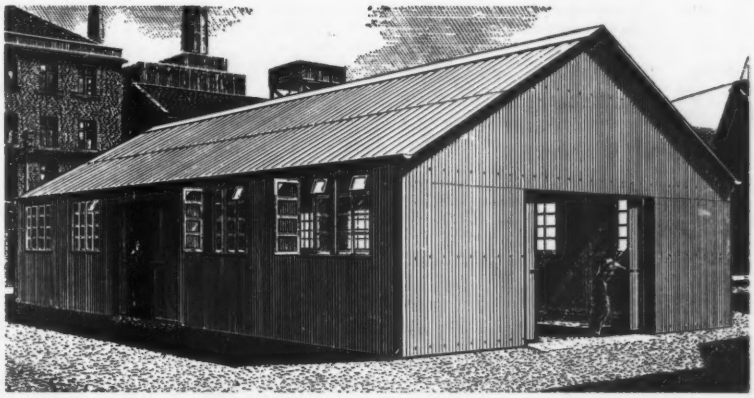

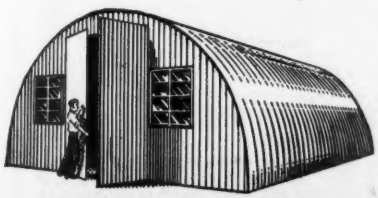

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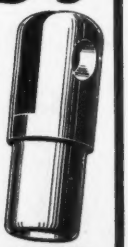

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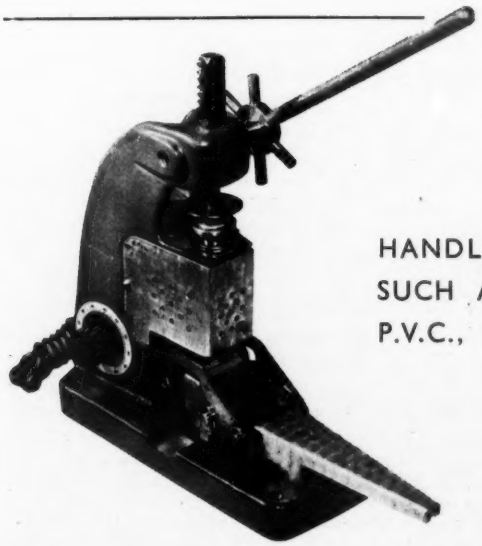

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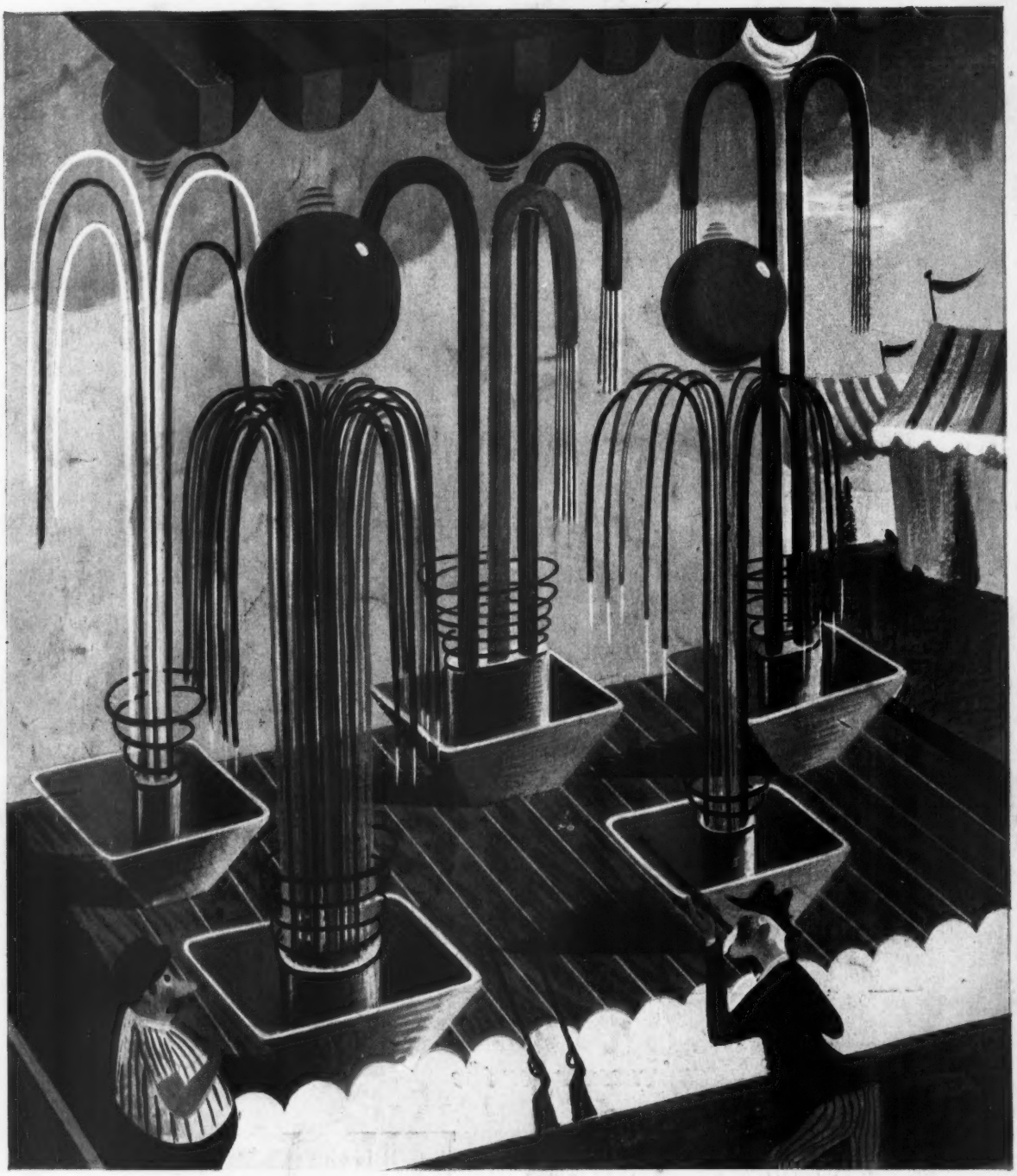

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